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ECHOES OF THE BALTIMORE MEETING.

The telegraphic correspondence from "Three Stars," published in our last in respect to the regular business proceedings of the 17th annual meeting of the American Gas Light Association, makes this current mention all too dull. Still a few more sounds in echo of the meeting may not be entirely without the pale of interest. Beautiful Baltimore never looked brighter than on the morning of the 16th, and President Slater had the satisfaction of greeting and directing, in the charming concert hall of the Concordia Opera House, a truly representative gathering of delegates. Some, it is true, of the old guard failed to respond to their names; and the Secretary's report told in cold type the lamentable fact that death had made sad inroads. Hon. Member R. P. Spice was one of those whom death had called away, and the fact is but feebly expressed in the assertion that memory dwelt sadly over him. But as it is the living who are kings, we may turn aside from the sadness of our loss to joyously hail the living.

England was represented in the persons of two of her clever sons—Mr. Corbet Woodall, Past President of the Association in England that corresponds to our American Association, and a gas engineer as well whose fame is world-wide; the second representative was Mr. Ellice-Clark, whose off-handed style soon caused him to be on good terms with everybody. Of our home notables who are not often seen at the American Association gatherings might be mentioned, rotund Secretary Littleton, of the Western Association; ex-President Vanderpool, upon whose shoulders time lightly rests; Commissioner Barker, of Massachusetts; Gen. Wagner, Director of Public Works, Phila., Pa., and others. But as the roll call and "official report" will reveal these things to the careful reader, we may pass on to other matters that the screed will not so plainly show. In passing reference to the President's address (and Mr. Slater, despite a decidedly depressing bout with facial neuralgia, proved himself a splendid director) we may say that if those who are so pronouncedly anxious to solve certain weighty problems connected with the supply of artificial mediums for light and fuel, but who rely for their proof of solution on *ipse dixit* instead of demonstrated fact, will but study the Slater way of putting it, their advance to real success will be in no wise retarded.

Coming to the papers, it can be said that they in every sense bore out what had been predicted of them; for, taken as a whole—even though we differ materially from some of the conclusions enumerated—the paper list of Baltimore probably outranks any other list ever brought to an exposition before the American Association. As one light outshines another, however, we think that the palm for "finish" ought to be awarded to Prof. Love, whose paper on "Gas Calorimetry" bears the mark of a master. Perhaps Mr. Pearson's paper attracted the greatest general interest; for the subject of the "Conduct of the Electric Light Business in Connection with the Gas Industry" is a living issue, and one that is largely held to be debatable, so far as an affirmative answer to such "connected operation" is concerned. We are fain to admit, however, that the proponents of the plan constantly gather recruits. Another paper of a strictly technical sort that was well received was submitted by Mr. Rowland. "The Care and Operation of Gasholders" are subjects that appeal to every engineer; and it is to be regretted that

the lateness of the hour at which it was read—if the programme erred at all it was on the side of prodigality—prevented a proper discussion of its points. Taken as a whole, however, what we said above as to the intrinsic merits of the Baltimore paper list must go as our deliberate verdict.

The shrewdly concerted plan adopted by Secretary Humphreys, in respect to having the contents of the "Question-Box" well advertised in advance of the meeting, proved itself in the results obtained. Were it not for the practice adopted the list could not have been disposed of in the time that remained after the papers were read. By the way, it should be borne in mind that the Secretary displayed a great deal of grit in reporting for duty on the second day. He was really a sick man.

Having been enabled to justly declare that the business portions of the sessions were eminently successful, it only now remains for us to add that the sequel to the efforts of those in charge of the arrangements for entertaining the delegates and the guests was nothing short of perfection. While the sterner sex were carrying on the business proper of the convention, the ladies—and a numerous and charming delegation they certainly were—in the especial charge of Mr. Chas. H. Dickey and his competent aides, were afforded ample measure of enjoyment. Sight-seeing, theater parties, etc., prevented any dull moments. Perhaps, and to go a little ahead of our story, the appearance of the feminine delegation for a moment in the main gallery of Concordia Opera House during the banquet—they were *en route* to the hotel from a theater party—was one of the most enjoyable and applause-provoking incidents of the meeting. The Concordia Opera House never in its history presented such an animated scene as when the guests sat down to partake of the beautifully prepared and brilliantly arranged banquet tendered the Association by Messrs. Bartlett, Hayward & Co., of the Monumental City. Everything was on a superb scale—the lighting, the decorations, the viands, the wines. The hosts were truly hosts, and the guests will long remember their "welcome," which was as brilliant as the flaming letters in the foreground that proclaimed it. At such a remote period from the hour of the feast it is perhaps as well to simply say that the festivities of the evening could not be surpassed. As it was with the evening of the 17th, so also was it with the pleasures of the outing on Friday. The trip to Steelton and the excursion over the broad and ripplelessly waters of beautiful Chesapeake Bay were enjoyed to the full, and Dickey's blushes at the encomiums constantly uttered in respect to the hospitality of the Maryland Meter and Manufacturing Company, under whose auspices this portion of the entertainment was provided, were proof that his and their efforts were appreciated to the full. The subsequent ride to Druid Hill, participated in by the ladies, while their escorts visited the Bayard street station of the Consolidated Gas Company's plant, together fittingly brought to a close a grand outing-time. In conclusion, and as a preface to the subjoined "Afterthoughts," by "W. M.," we can but say that the 17th annual was a grand success.

AFTERTHOUGHTS OF THE SOCIAL SIDE OF THE SEVENTEENTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.—The future has rolled through the present and become the past; or, in other words, the 17th annual meeting of the A. G. L. A. has come and gone. How time does fly! Here we are bowling on towards the next annual meeting, and the local conventions that lie between. Evidently the old man of the scythe and hour glass is attending strictly to business.

Fortunately for us we can recall at will the memories of the enjoyable time we had; the pleasant faces of the friends we met; the rollicking feast of reason and flow of soul at the banquet; the delightful sail down the Bay next morning; and the final wind up at the works of the Consolidated Gas Company, which final ovation took place in the coal shed—swept, garnished and whitewashed, and also well supplied with the liquids and solids, so necessary to the welfare of the average gas man.

Too much praise cannot be given to our trio of hosts, Bartlett, Hayward & Company, the Maryland Meter and Manufacturing Company, and the Consolidated Gas Company—needless to say, all of Baltimore.

The attention to the ladies, and the carrying out of all the details necessary for the entertainment of so large a company, deserve the highest praise.

The decorations of the banquet hall were unique and emblematic of the profession. I cannot refrain just here from complimenting Messrs. B. H. & Co., and the Maryland Meter Co. on their modesty in not showing their guests through their respective works, which I am sure would have been interesting to many of them.

By the way, what an entertaining speaker is our English friend, Mr. Ellice-Clark. His description of the revivification of foul purifying material by the use of oxygen was most interesting, and will no doubt incite some of those who heard him to investigate the matter more fully, and to carefully watch the results of Mr. Valon's experiments in the future. Mr. Ellice-Clark proved also a good speaker at the social board, and is just the kind of Englishman we like to meet. In fact—

> "It's greatly to his credit,
> For he himself has said it,
> That he is an Englishman."

What shall we say of our perennial, night-blooming toast-master? Does he use the elixir of life, or what does account for his perpetual youth? He should, by all the laws of nature, have been baldheaded years ago. What shall we do when he is gathered in? I propose that for the remaining meetings that he is with us, that his sayings be recorded on one of the largest sized phonographs. Then in some future meeting, say, about A. D., 1999, the crank will be turned, and forth from the speaking cylinder will come, in the well-remembered silvery tones: "Gentlemen of the American Gas Light Association, and fellow revellers. It is with pleasure that I stand before you this evening," etc.

Mayor Latrobe, of Baltimore, and Director Wagner, of Philadelphia, proved that even they, occupying the lofty pinacles they do, can unbend and conduct themselves like common mortals bent on having a good time.

We missed some familiar faces this year—the jovial Benson; that old salt, A. C. Wood; Greenough, of Boston; Jas. R. Floyd, and others.

It makes us feel old when we observe the large crop of young men who are coming to the front and slowly but surely crowding the older ones out.

Well, the Association will soon be of age. Let us see, in 1892 it will be 20 years old. Now, if it had been one year older, we could have celebrated that event at the same time with the World's Fair in New York at that date.

That reminds me that if that letter from the Mayor of Chicago was not of the same kind as the letters of regret from Queen Vic., Boulanger, *et al.*, then he must be a person of monumental cheek and unparalleled audacity. Only words of superlative degree will suffice to describe him. Why, it was only a few years ago when the wild, untutored American Indian was chasing the buffalo, or taking the superfluous hair from his neighbor, on its very site. Mr. Mayor, the World's Fair will be held right here in the metropolitan city of the United States, to wit, New York. Mr. Mayor, too previous art thou! Go to! but let up on 1892.—W. M.

THE STEELTON GROUP PHOTOGRAPH.—We are requested by Mr. C. H. Dickey, of the Maryland Meter and Manufacturing Company, to publish the following:

The photograph taken on the trip to Steelton, while the Association was in convention at Baltimore, IS GOOD. The photographer will furnish same on the following terms: From 1 copy to 50 copies, $3.50 each; 50 to 100 copies, $3 each; from 100 copies up, $2.50 each. It is therefore requested that all wishing this photo will please send their orders at once to Mr. C. H. Dickey, care Maryland Meter and Manufacturing Company, Baltimore, Md., who will attend to same. Remittances can be made, after receipt of photo, direct to the photographer. Two negatives were taken, but only one will be finished up. However, in case anyone finds that his portrait is blurred on the copy received by him, he can change same for the other, as no one face is blurred on both negatives, and but two or three faces are blurred at all.

DEATH OF MR. ALFRED ARDNT.—We regret to have to chronicle the death of Mr. Alfred Arndt, Engineer of the Chicago Gas Light and Coke Company, whose demise occurred at the Clarendon Hotel, Chicago, on the 17th inst. Mr. Arndt was a native of Australia, and was in his 44th year. He was elected to membership in the Western Gas Association at its meeting in Chicago, in 1888. He was a capable gas engineer, and a man in the fullest sense. We hope to shortly present a suitable obituary notice of deceased.

THE petition for the right to operate a fuel gas plant in Appleton, Wis., has been granted. Under it the operators agree not to charge in excess of 40 cents per 1,000 cubic feet for gas for cooking and heating.

THE Schultz Gas Fixture and Art Metal Company, of Baltimore, Md., has been awarded a contract by the U. S. Government to furnish gas fixtures for the public buildings now in process of construction at Des Moines, Iowa; Augusta, Me.; Reading, Pa.; Keokuk, Iowa; Santa Fe, New Mexico; Fort Scott, Kas.

(Continued from p. 540.)

Instruments for Measuring Radiant Heat.

By C. V. Boys, F.R.S.

Now, having obtained quartz threads, it is necessary to describe their properties. In the first place they can be made as fine as anybody is likely to want them; threads as fine as one ten-thousandth of an inch are perfectly manageable, and can be had in pieces yards long, if required. Threads as fine as one hundred-thousandth of an inch can be made, but are not easy to handle. This will be the more readily understood when I say that a bundle of 10,000 of such threads would be no larger than a single piece of spun glass. How fine the finest ends of some of the fibers that I have made may be, there is no means of telling. Dr. Royston Pigott, F.R.S., believes them to be less than one-millionth of an inch in diameter, and I have concluded from their appearance in the microscope—but this is hardly the right expression, for I have not been able to trace them to their end because they are far too fine—that they cannot be much more. These certainly cannot be handled or used as torsion threads. As it is impossible to realize what numbers such a million really means, I may say that a piece of quartz one inch in diameter, would if drawn into thread one-millionth of an inch in diameter, produce more than sufficient to go all round the world 650 times, or an express train traveling without ceasing would take thirty years before it could unwind this amount if wound on a reel.

The next quality that I must refer to is the strength of quartz threads. Experiments made with great care by Mr. Highfield and myself in the physical laboratory show that, as in the case of glass, these threads became stronger in proportion to their size as they are finer. A quartz fiber rather finer than spun glass, with a diameter of 6.9-10,000ths of an inch, has a strength of 8×10^9 dynes to the square centimeter, or of 51.7 tons to the square inch. A fiber with a diameter of 19-100,000ths of an inch has a strength of 11.5×10^9 dynes to the centimeter, or 74.5 tons to the inch. This is a great deal stronger than bar steel.

Thus quartz fibers have the two valuable properties that they can be made as fine as you please and are of enormous strength. We have also found that when the outsides of fibers of spun glass or quartz are dissolved with hydrofluoric acid, the strength goes on proportionately increasing as they get finer, showing that in the case of fine fibers the great tenacity is not due to a vitreous skin. Fibers, originally of various sizes, after being dissolved away till they have the same diameter, have approximately the same strength, which shows that the great strength of fine fibers is not due to their being formed under pressure. (The pressure due to a surface tension equal to that of water would, in a fiber one-millionth of an inch in diameter, be equal to 60 atmospheres, and in thicker fibers less in the same proportion.) These experiments point to the conclusion, not verified in other ways, that there is something analogous to surface tension in the solid fiber.

The next point to consider is the elasticity of the fibers both to stretching and to torsion. Experiments in this direction, I hoped, might throw some light on the cause of the enormous strength of fine fibers. I have on the table the apparatus that I devised for this purpose (Fig. 8)

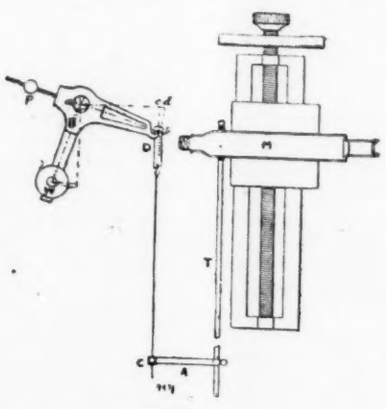

Fig. 8.

The apparatus made by Hilger consists of a microscope cathetometer shown in the figure at *M*, which can be made to traverse a vertical slide by means of a fine screw having a micrometer head, the divisions of which are capable of being read directly to the one-thousandth of a millimeter. To the end of the microscope farthest from the eyepiece is attached the vertical tube *T*, which carries at its lower end an adjustable arm *A*, fitted with a clamp *C*. To the end of a separate bracket is fixed the block *a*, which supports, by means of a knife-edge, the beam *B*, which is weighted with a gravity bob *W*, and carries on a second knife-edge *b*, the micrometer scale *D*, the opposite end of the lever being counterpoised by the adjustable weight *P*. The fiber to be tested has attached to it a pin at each end to facilitate its being fixed in the apparatus, it being stretched vertically between the scale *D* and the clamp *C*.

When the micrometer head is turned, the cathetometer *M* is lowered, carrying with it the tube *T*, and thereby putting a tensile strain on the fiber, which draws down the lever *B*, being itself stretched under the increasing pull of the lever. The extension of the fiber is measured by the movement of the scale *D* across the field of the microscope, and the deflection of the lever *B* is a measure of the force that is being applied to the fiber, which is obtained by subtracting the amount of extension of the filament from the distance traversed by the microscope, which latter may be determined with the greatest accuracy by the readings of the micrometer head.

In adjusting the instrument the slide is first made vertical by levelling screws, the accuracy of the levelling being determined by means of a spirit level placed in different azimuths on the top of the micrometer head. The counterweight *P* is next adjusted until the knife-edges at *a* and at *b* are both in the same horizontal plane, and this adjustment is made when the scale *D* and the upper attachment pin of the fiber are in their proper position, and the microscope is focussed so as to give a sharp definition of the divisions on the scale. The fiber having been attached to the upper supporting pin and suspended in its place, the length of the arm *A* is so adjusted that the lower supporting pin of the fiber hangs freely in the axis of the clamp *C*, which is then tightened, and thus perfect verticality at the commencement of the pull is ensured. The micrometer head is then slowly turned, readings being taken as each division of the scale *D* traverses and coincides with the cross wire of the microscope, and the force which thus extends the fiber by each increment of one-twentieth of a millimeter is determined in the following way:

If the adjustments of the instrument have been made in the manner described above, the moment due to a vertical pull is proportional to the cosine of the angular displacement of the beam, while that due to the gravity bob and the other portions of the beam varies as the sine of that angle, the actual tensile force applied at *D* being proportional to the tangent of the inclination of the beam. The vertical distance *c b* is a measure of the sine of the inclination, and when the angular displacement is small this distance is practically the same as the tangent of the angle, and it may be corrected to measure the tangent if very great accuracy be required. The true value of the force corresponding to various values of *c b* may, however, be more easily found by attaching weights to *D*, and observing, by means of the microscope and scale, the weights which produce corresponding deflections.

In this instrument there are two apparent sources of error, which, however, do not in any way affect the accuracy of the measurement. In the first place, it is evident that as the beam is deflected, the point *b* becomes more and more distant from the microscope, and the pull on the fiber ceases to be vertical, but it must be also noticed that in doing so the scale *D* is carried out of the focus of the microscope, which has in consequence to be adjusted by being moved forward to the exact amount which the scale has receded by the movement of the beam, and thus the arm *A* carried by the end of the microscope is moved forward to an equal extent, the scale comes again into focus, and the fiber becomes again vertical.

Again, in the case of the tube *T* being very long, it might happen that the spring of the tube and of the arm *A* might cause the fiber to appear more stretched than it really is; but the error due to this cause can be perfectly eliminated by finding, in the course of the experiment, the force that is being applied to the fiber, and afterward placing weights on *C* until a pull of the same amount is obtained. As a matter of fact, however, with ordinary fibers the further movement of *D* under these circumstances is not observable.

Messrs. Gibson and Gregory used this apparatus for a very large number of experiments, which they conducted with great care and exemplary patience. They examined fibers both of glass and quartz. The mean value of Young's modulus found for spun glass is 5.16×10^{11}, and for quartz about 6×10^{11}. The modulus of torsion was observed in the usual way, with the following results: Spun glass, 3.22×10^{11}; quartz, 3.74×10^{11}. The rigidity is, for spun glass, 2.05×10^{11}; for quartz, 2.38×10^{11}.

There seems a good deal of variation between different specimens, but these figures go to show that the elasticity of spun glass is much the same

as that of glass in mass, and that quartz is very slightly stiffer than glass.

The only serious fault of glass fibers is the fatigue, which I experimentally showed in the early part of this lecture. I shall now perform the same experiment with quartz, and it will at once be evident that the fatigue of quartz, if it exists, is nothing in comparison with that of glass. As a matter of fact, this fatigue does not cause a change of zero of $\frac{1}{5000}$ of the corresponding change in the case of glass, and it may be less; but practically it is quite beyond our power of observation to detect any effect with such deflections as are met with in the practical use of instruments.

Quartz, then, has these properties: It is, when in fine threads, stronger than the metals, and so a finer thread of this material will carry a given weight than can be made of any other material. The torsion of quartz is but little more than that of glass, and is less than a third of the torsion of steel; therefore the small torsion due to a very fine fiber is made smaller still on this account. Then since it is practically free from fatigue, since it is not affected by moisture in the air, nor liable to all the vagaries for which silk is so famous, and since it may be easily made in pieces of almost any length, there is no reason why silk should still be used. I have now for some time been making experiments with quartz fibers, that would have been, as far as I know, quite impossible with silk, without meeting with any trouble, and to me it seems, in the light of my experiments, to be unwise to use silk in instruments of precision. I may add that I am not trying to find a market for anything of mine, for these fibers are not patented—they are free to the world to use.

As an inventor or discoverer is apt to form too favorable an opinion of anything that he may have done, I shall refer to the experience of others with quartz threads.

Professor Threllfal has found it possible to improve the galvanometer by various modifications until it is from 100 to 1,000 times as accurate and delicate as a measuring instrument as any that can be made in the usual way. It was only when he used quartz that he was able to make any real advance; with silk instead of quartz his instrument was practically no better than any other. This experience I particularly value because he was very sceptical as to the truth of what I had said about the value of fibers of quartz.

Professor J. Viriamu Jones writes:—"You may indeed say that I find the quartz fibers an advantage after silk. I could not get in my low-resistance galvanometer (with an ordinary Elliott needle) a constant zero with a period of oscillation of three or four seconds; with your fiber I can get constancy with a period of at least 20 seconds. It has always seemed to me that in a very weak field a galvanometer needle suspended by silk indicates that the silk twists and untwists in the most unreliable and variable manner. Your fiber, on the contrary, in the weakest field I have put the needle in, maintains constancy of equilibrium. * * * You are a benefactor of mankind."

These are not the only instances in which my experience has been fully confirmed by others. It is in consequence of these independent opinions that I have ventured to express myself in the way that I have with regard to silk.

There is another property of quartz fibers and rods which may be found to be of some importance. A stick of clean quartz in a damp atmosphere is an almost perfect insulator, while a piece of glass is, judged by the behavior of the leaves of gold, an almost perfect conductor. Not only may quartz be used in a damp air, it may even be dipped in water, and gold leaves may be hung on it immediately, when it will be found to insulate just as well, even though the water is still visibly clinging to it.

This high insulation of quartz, even in a wet place, may make it possible to construct electrostatic measuring apparatus which will always be ready for work, and in which sulphuric acid need not be used. But here I am leaving my subject. Going back to quartz threads, it is a curious fact that the ends of many of these become highly electrified in the process of manufacture. Whether it is the friction in passing through the air, or whether it is electrification produced in the oxy-hydrogen flame, I do not know, but the fact remains that the floating ends of some of these threads are very highly electrified, and the electricity, small in amount on account of their extremely small capacity, is absolutely unable to escape, but it makes its existence evident in a very curious way. The ends of these fibers, as seen floating, often assume a spiral or wavy form, and these screws serve as excellent instruments for revealing the presence of electrification, which I believe is too small in quantity to show on any apparatus. If you gradually approach the hinder end of one of these electrified screws it suddenly shoots itself out, and the fiber is projected on to the approaching body. This may be repeated several times.

It is for this reason, I believe, that it is possible to gather the extraordinary material which you now see upon the screen. If you take a strong oxygen hydrogen jet, and keep joining and separating two sticks of quartz in the flame, a very great length of a complex cable is shot away, but it is so fine that it will float away and be lost. If, however, you place in the line of the flame, but a foot or two away, a retort stand or other convenient support, you will find this covered with long threads of this multiple cable, consisting of fibers of all sizes, from one five-thousandth of an inch downwards. By varying the size of the flame, the proportion of the gases, and the place at which the quartz is held, you can produce anything between this complex cable, down to those fine tapering tails which no microscepe can follow to the end. The following hints may be of use to those who are going to mount apparatus upon fibers for the first time. Having chosen a fiber of the right diameter and longer than is ultimately required, the first thing to do is to fasten a small fragment of gummed stamp paper to one end. This acts as a weight, and makes the following processes more easy. The upper or fixed support must next be fastened to the free end of the fiber. I prefer a common blanket pin passing through a cork to any of the more elaborate contrivances in common use; however, whatever is going to be used for the fixed support should be pointed at the lower end.

If the needle or other thing to be supported is very light—that is, nowhere approaching the breaking weight of the fiber, shellac varnish is the best thing to use as the cement. Just moisten the last five millimeters above the pin with this varnish, and—holding the fiber near its free end in one hand, and the pin in the other, with the little finger of one hand resting against the little finger of the other, for the sake of steadiness—immediately apply the fiber to the varnished surface, to which it will stick. Then pull it endways through a distance of half a millimeter about, to make sure that when all is dry there will be no sudden bend in the fiber. A hot piece of wire, or knife, or pair of pliers must then be applied to the pin above the varnish, so that the heat may be conducted down slowly to drive off the remaining alcohol and melt the shellac. After this the fiber is securely held at that end.

If the thing to be supported is very heavy, varnish is not so good as melted shellac, but this is much more difficult to apply. The pin must be warmed and smeared near the joint, and while hot the fiber must be applied and slightly pulled. Whether varnish or melted shellac is used, it is essential to work in a proper light. A table in front of a large window in the day, or supporting one or two movable gas burners at night, will do perfectly, provided that a really black background exists, upon which the fiber may be made evident. Black velvet, or paint or paper is no use whatever. The only background that does well, and one that is easily arranged, is the darkness inside a drawer just pulled out an inch or two.

Assuming that one end of the fiber is properly fastened, the next thing is to determine the exact length required. For this purpose I always make a drawing on a perfectly clean and smooth board, showing the point of the pin at one end, the extreme end of the thing to be supported, and the position of the mirror or whatever determines the length of the fiber.

The holding-pin is then raised up until the paper weight is hanging in the air. This is then allowed to rest on the board and slowly dragged along until the point of the pin is exactly over the corresponding mark on the board, and the paper wafer is in the line of, but beyond, the other mark. The fiber is then straight, and must pass over the mark which indicates the upper end of the apparatus that is to be suspended, though, of course, nothing can be seen. A knife is then drawn across the board, say, five millimeters beyond this mark. By this means the fiber is cut, and the five millimeters are left for the purpose of attachment. The needle or suspended thing is then fastened in the same way as the pin. It is well, then, to drag the needle along until the mirror is exactly over its place on the drawing, and see i the upper pin is also in its place. By warming either pin, and pulling the fiber, a slight alteration can be made if necessary.

The paper weight with the remainder of the fiber may then be taken up, and the free end fastened on a microscope slide and labelled, so that the diameter of the fiber may at any time be found. If the fiber, illuminated by a distant light, had been examined with a prism first, and the dark bands of the spectrum had been found straight and uniform from one end to the other, and it is only such fibers that I use, then the diameter must be the same over the whole length.

Though I have given a large proportion of the time at my disposal to this one part of the subject, I hope that it will not be considered that I have occupied more time than is demanded by the importance of the subject or the value of the results, of which some are now published for the first time.

[To be continued.]

Inaugural Address of President Robert Bridge.

[Read at the current half-yearly meeting of the North of England Association of Gas Engineers.]

Gentlemen—In electing me as your President, you have conferred an honor on me which I highly appreciate, and for which I tender you my warmest thanks. Proud as I am of the position, I fear I shall not, in the remarks I am about to offer, say anything to justify my selection; but I shall do my best to lay before you a few points bearing upon our industry, which, if they first of all stimulate thought and then action, I shall feel amply recompensed for any little trouble I have been at in selecting and linking these points together.

I have nothing novel or original to submit for your consideration. Research into the laws that regulate the production and formation of gases is of the utmost importance and value; but in order to perform this work satisfactorily, three things are essential—the trained and well balanced mind, ample leisure, and plenty of funds. Now, the older members of this Association do not require to be reminded that technical training schools did not exist in their younger days, when the receptive faculties were keen; and that consequently they did not enter upon their duties as managers of gas undertakings as fully equipped in technical detail as the generation now coming to the front. It is to their credit, however, that they have, as a rule, met and overcome difficulties which their successors will never be called upon to contend against. But even assuming that a man entered upon his duties with a fair knowledge of physical laws and of the chemistry of the compounds of coal gas and its bye-products, if he is to apply that knowledge to secure present and future benefits to his employers, he must have leisure to prosecute his projects; and, having arrived at certain definite conclusions, he must have the means to give effect to them. I am afraid that, in the majority of works in this country, the leisure to experiment is difficult of attainment, and the funds to demonstrate are not always forthcoming.

We live in go-ahead times. Shareholders want a quick return for their money; and members of corporations apply profits in relief of rates, not always because they believe the principle is right, but in order to secure for themselves popular favor at municipal elections. The servant of these bodies, therefore, must be upon the alert to avail himself of the discoveries made by more fortunate brethren; and while he keeps one eye upon the results flowing from original research, he must keep the other eye upon their commercial advantage. Not only has he to do this, but he must never forget that the field of artificial lighting is not now entirely in the possession of gas companies. The electric light, as a powerful illuminant, seeks to supplant gas lamps on the public thoroughfares; and the incandescent electric lamp and the much-despised oil lamp are worming themselves into favor with certain classes in the domestic circle. Recently, too, water gas has threatened to oust coal gas from the manufactory, and to try conclusions with other illuminants in lighting large buildings. I am, as I have already indicated, in the unfortunate position of not being able to submit any considerations founded upon original research upon these subjects; but, in lieu thereof, I propose to occupy a portion of your time in giving expression to some thoughts which have occurred to me in connection with them.

First, then, with regard to electric lighting. If anyone takes the trouble to read the record of this system of lighting, from its meteor-like appearance in 1878 or 1879 down to the present moment, he will be astonished, not only at its commercial fluctuations, but at the progress it has made. The financial convulsions which succeeded its advent were not long in subsiding. In a brief space of time fortunes were lost and made. The outburst was succeeded by a calm. Although Stock Exchange sharpers could no longer delude the public with glowing accounts of the future of the electric light, yet scientists who had set their minds to the solution of the all-important problem of how the electric current could be manipulated, did not rest from their labors. From time to time they have made discoveries in the direction of cheapening the cost of production and improving the steadiness of the light. It would not have been very creditable to science had advances not been made. The ablest physicists and mathematicians of the century have been working at the problem from various points of view. The steam engine to drive the dynamo has been made as perfect as human ingenuity can suggest; the dynamo has been improved, so that now much superior results are obtained at a less expense than was possible two or three years ago; and last, but not least, the introduction of transformers enables electricians who believe in sending out a high potential current from a central station, and thereafter to distribute it at low pressure to customers to give effect to their ideas. This system is said to be more dangerous to work than the other, of supplying a low potential current from a variety of stations. But both systems are to be applied in London; and experience will soon tell which is the better and more economical. Mr. Ferranti, the electrician of the London Supply Corporation, is the apostle of the high initial potential system. The works of this Company at Deptford are on a gigantic scale. Arrangements have been made to supply over two million lights of 10-candle power each. When I mention that there are six or seven other companies, each preparing to supply hundreds of thousands of similar lights, we must conclude that there is to be serious competition for public and private lighting. These facts stare gas manufacturers in the face, and we must admit that they are ominous. That important advances have been made in electric lighting must be frankly admitted; and credit must be accorded to the electricians, who have by their inventions enabled these advances to be made.

While I am prepared to make this admission, it does not follow that I think the new illuminant is likely to injure the gas industry. With all its advances, and with all the cheapening processes that have been brought into play, the electric light is still twice as costly as gas, even when gas is consumed in the wasteful way that widely obtains. And if the cost per unit of light is taken, and if we employ the latest types of regenerator lamps in making comparisons, I unhesitatingly affirm that the electric light is four or five times more expensive than gas. I reason from this that the electric light will not interfere with the prosperity of gas, except in a limited sense. A certain section of the community will doubtless adopt the light. It is new, it is fashionable, and "faddists" say that it is healthier than gas. But, with the great section of the British public, novelty has few charms when it means additional annual outlay; nor does the idea of being in the fashion with light exercise much influence upon merchants, whose eyes are constantly fixed on the money columns of their ledgers. Those who argue in favor of the electric light on sanitary grounds know that, where incandescent lamps are used in a room, there is an absence of ventilation. I may say that I recently heard a gentleman speak of a certain hotel in London, the dining room of which is lighted with glow lamps. He said that it was so stuffy that gas had to be used to improve the ventilation. When we consider the light itself, we cannot give it unconditional approval. The lamps are said to give out light equal to 10 or 16 candles, as the case may be; but it is notorious that, after they have been in use for some time, the intensity of the light decreases. I cannot give a scientific explanation of this; but several cases have come under my notice where tests have been made, which showed that lamps were not giving much more than half the amount of light bargained for. The most recent instance in point is the little town of Conshohocken, in Pennsylvania. The authorities entered into a five years' contract for a hundred 25-candle power incandescent lamps. Not being satisfied that the contract was being fulfilled, an investigation was made; and it brought out that on one night the average was 12.23, and on another night 15.25 candles.

Despite the recent improvements which have been effected in the lamps and the mode of using the current, there have been miserable failures to maintain a supply. Particularly I would refer to Barnet and Leamington. Possibly the failures there are due to causes which additional outlay would remedy; but such an explanation has not been given. A week or two ago an installation was opened in Bradford, where the Corporation have spent from £20,000 to £25,000. Report speaks favorably of this installation, but it has not yet been established long enough to enable one to come to any conclusion regarding it, whether of a favorable or an unfavorable character. In Leeds, and in several other large provincial towns, preparations are being made to introduce the new illuminant; whilst in London the electric light is being largely used at the West End. Immense sums of money have been spent in erecting plant and laying down mains to supply the metropolis. We will wait with interest to see whether these companies are able to commend themselves to public favor. Even should they prove successful, gas managers need not be downhearted. It is notorious that wherever the electric light has been introduced, and has been fairly maintained, the demand for gas has increased. This may have been because the bright light upon the streets causes people to be more liberal in their use of gas when they get home; or it may be that gas companies have now an incentive to push for business in other directions—as, for instance, cooking and heating, and motive power—and that their efforts are being crowned with success. In London the returns of gas companies continue to show an increase. The same may be said of Paris. In Berlin, the yearly percentages of increase in the manufacture of gas since 1879–80 have been 1.2, 2.5, 4.0, 3.7, 3.1, 3.4, 4.7, 4.4, 6.39. This greatly increased rate of increase has been attained in face of the fact that at Berlin the number of electric installations grew during these years from 333 to 459; the number of arc lamps, from 1,554 to 2,249;

and the number of glow lamps, from 22,363 to 45,552—that is, from about 3.1 to 5.9 per cent. of the whole lighting of Berlin. The localities most brightly lit up by the electric light have had specially large rates of increase in gas consumption; these going up as high as 8.5 and 10.5 per cent. These are encouraging figures; and they bear out my conclusion, that should the electric light find favor in the eyes of a section of the community, its introduction will aid rather than injure our industry.

I now turn from the consideration of one branch of artificial lighting—a branch which, within a decade, has swallowed up millions of money—to another, which has been foisted on the public with much trumpet-blowing and beating of drums. I refer to water gas. Now, gas managers are not the men to decry any movement which has for its object the substitution of gaseous for solid fuel. They are too familiar with the enormous waste which results from the combustion of solid fuel in open grates, to oppose reform, they also know that the products of such combustion not only pollute the atmosphere of our towns, but in some respects render town life miserable. To fuel gas everyone must look for the conservation of the stores of coal locked up in the bowels of the earth, and at the same time for the purity of the atmosphere which is essential to the health of every human being. But the question presents itself, What sort of gaseous fuel must be used? "There's the rub?" Naturally, as gas men, we say coal gas. But the advocates of water gas, which has recently sprung into prominence in this country, maintain that if reform of the smoke nuisance is to be effectual, water gas must be used; their arguments being founded mainly on the not generally accepted assertion that it is cheaper than coal gas. That a larger yield of gas per ton is obtained by passing steam through incandescent coke than by destructive distillation goes without saying; and that the water gas is not so liable to deterioration as the coal gas through the application of pressure, or because of variations in external temperature, must be admitted. But various objections have been raised to the universal employment of water gas. The principal objection stated (by people who do not take into account mechanical difficulties) is that the gas is highly poisonous, and consequently dangerous to life—its poisonous properties not being made evident before the victim has started on that journey whence no traveler returns. This, however, is an objection which can be easily overcome—that is to say, the gas may be made to smell, and that, too, most villainously, so that, should there be an escape, its presence in the atmosphere makes itself instantly apparent. My principal objection is not to the gas itself, but to the way in which it has been publicly advertised as the panacea for all gas ills and bills. Regarding it, statements have been submitted to the public of a misleading character; and many members of the community who, carried away by the rosy-hued statements, invested their capital in this new-fangled undertaking, have had time to repent at leisure. Gas at 4d. per 1,000 cubic feet has charms to woo a coal gas ridden public. Why should they continue to pay 2s. 6d. and 3s. per 1,000 cubic feet for coal gas when water gas can be supplied for 4d. per 1,000 cubic feet? Such is the inconsiderate way in which many users of coal gas argue.

For metallurgical purposes water gas may be advantageously used; and in this field it may be largely employed in the future. But even here its supremacy is disputed by the advocates of producer gas. I will not enter into the respective merits or demerits of these gases; it would be foreign to the object I have in view. I want to say, however, that water gas cannot be sold to the public for domestic purposes at rates much below, if below, those now charged in many towns for coal gas; and consequently there will be no inducement to the public generally to encourage water gas companies. If the public are content to use magnesia or other metallic combs with a low quality gas, we are in a position to serve them; but before the public demand gas of low illuminating power, in order to have cheap heating and cooking fuel, I trust they will consider the question in all its bearings. Should they do this, water gas will be relegated to iron and steel factories, where its employment may result in economy of fuel and the production of better goods. Here I may mention that we have recently heard of a process whose birthplace is America, and from which great things are anticipated. This is the Loomis process. The inventor reverses the usual mode of admitting air at the bottom of the furnace. By means of an exhauster he sucks air, and afterwards steam, through the incandescent mass. The first products are producer gas, which may be used in gas works to heat the retorts; then, as I understand it, ordinary coal gas is obtained; and afterwards steam is passed through the mass and water gas is produced. This latter gas is mixed with the coal gas and sent out to customers. It is claimed for this system that the tar is nearly all converted into gas; that the final product contains a much smaller percentage of carbonic oxide than ordinary water gas, and that it has a high thermal value. I understand that the process is shortly to be tried by a firm in Sheffield; and we shall all be glad to learn further about the experiment.

Upon the future of water gas and coal gas I will not prophesy; but I have for some time thought that the day may arrive when gas companies and corporations may have to face the question whether it will not be a wise policy to reduce the quality of gas, and sell it at considerably lower rates than now prevail, and thus secure a large day as well as night consumption. I know that this will involve many mechanical changes; but if the necessities of the times urgently demand these changes, then suppliers must adapt themselves to the altered circumstances. Many of us here to day have seen cherished ideas concerning the manufacture of gas and the economies of its distribution rudely upset; and if we are to have a revolution in gas supply—whether for lighting, heating, cooking, or for motive power—let us be prepared for the altered state of things, so that we may continue to manage the works committed to our care with that degree of success which has rewarded our past endeavors.

I now pass on to the third subject which I indicated in my opening remarks, namely, that of oil. Of the three competitors of coal gas in the field, this is perhaps the most insidious. It drains gas companies of customers one by one; and once they have come under the influence of oil, it is no easy matter to get them to return to the gas fold. The reason why so many people use oil is apparent. They are not called upon to pay for the laying of service pipes; they are not required to pay for gasfittings; it is not necessary that they should pay meter rents; and, lastly, they are not compelled to deposit a certain sum with the treasurer of a company or a corporation before they are allowed to get, not a luxury, but one of the necessities of modern civilization An oil lamp to suit all tastes, from the tenpenny life destroyer to the æsthetic model suited to the drawing room of the successful tradesman, may now be had in every town in the United Kingdom; and oil can be obtained to fill and replenish these lamps at an almost nominal sum. By using oil, the householder is free from all the harassing restraints imposed by gas companies in olden times. They may follow their own sweet wills in the number of lights they shall have; and they may regulate the size of those lights by the quantity of oil they may be able to purchase. Now, having a knowledge of these facts, is it not suicidal policy for a company to refuse a supply of gas because a would-be customer will not pay a few shillings for a service pipe? This would-be customer argues that he may remove to another town, or another part of the same town; and that, therefore, to pay for a service is just to give so much money to his successor. A gas company cannot argue in this way. When a service has been laid, it is laid for all time—for present as well as for future occupants of the house—and the service being there, the chances are all in favor of the assumption that the new tenant will use the gas supply. Some time ago I took pains to ascertain how much oil came into Doncaster, and, to my astonishment, I learned that the quantity was upwards of 1,000 tons annually. I do not know how long this state of affairs may continue, because I may say that within the past twelve months we have in the town given services free and abolished meter rents. The discontinuance of the meter rent was equivalent to a reduction of 5d per 1,000 cubic feet to one-sixth of our consumers. Already I begin to appreciate the beneficial effect of these measures in the increased number of consumers and the increased demand for gas. I am decidedly favorable to the removal of all artificial obstructions to consumption of gas. Manufacturers, whether they be corporations or companies, cannot too soon recognize the fact that they must conduct their business on commercial lines, and not only remove antiquated obstructions, but push for business in the same way as a modern business house. Mr. Cox, Jr., of Sunderland, is to favor us with a paper on "Gas Popularization." I trust the views he will enunciate will help us to see ahead more clearly than we do at present.

We occupy a unique position in Doncaster. We are able to make any sort of gas we like here and supply it to the public without infringing the terms of the Act of Parliament under which we work. So long ago as 1827 it was determined to light the streets by means of gas. A company was then formed, the Mayor and the Corporation buying the greater portion of the shares for the burgesses of Doncaster. A Committee of Management was appointed. The then Mayor, Mr. R. Littlewood, was chosen as chairman. The clause in the Act which entitles us to make and sell any sort of gas runs as follows:

That the object of the said undertaking shall be as well the lighting of the streets, lanes, and other public passages and places within and in the vicinity of the town of Doncaster with inflammable air or gas to be produced from oil, coke, coal, or any other substance which the said Mayor, Aldermen and Capital Burgesses, for the time being, or the major part of them, in Common Council assembled, shall think best, as for

supplying such inflammable air or gas for lighting private houses, shops, manufactories, warehouses, or other tenements belonging to private individuals in the said borough and its vicinity.

There is another subject which demands consideration at our hands, as it is now forcing itself upon all communities. I refer to sewer ventilation. I know this subject has engrossed the attention of eminent engineers for some considerable time, and that a large amount of scientific and practical experience has been brought to bear upon it with varying success. I was induced some time since, in conjunction with our Medical Officer, Dr. M. Wilson, and our Borough Surveyor, Mr. Crabtree, to construct and erect a lamp to be fixed in connection with the sewer. The lantern, I may explain, is one of the ordinary high power type. Instead of being open at the bottom for the supply of air for combustion, it fits tight round an upcast pipe of 6¾ inches diameter. This pipe runs through the center of the lantern, its upper end being open to the atmosphere, and down through the column to the sewer. The lamp is lighted by six ordinary burners, each burner having a 4-feet per hour regulator, and the atmosphere for combustion is supplied through a series of holes in the upcast pipe at the base of, and inside, the lantern, so that whatever air is needed to maintain combustion comes from the sewer. In the shaft of the column, just above the plinth, a door is fixed for the insertion of the anemometer. From some experiments we have made we have obtained the following results: The sectional area of the upcast is 35 square inches; and the velocity of the current induced by the lighted lamps was 16,414 lineal feet per hour, or 3,989 cubic feet of sewer gas removed per hour. I am aware that the owners of other systems give figures far in excess of these; but as I have not patented mine, and as I am not running it for trade purposes, I give you the actual results. I saw, some short time ago, in one of the Leeds papers, that the Leeds Corporation were experimenting on the same lines as I have been adopting: and this convinces me that, although I may not have "struck ile," there is "ile" to be struck in this direction. My object in bringing this matter before you is to induce the younger members more especially to give this subject their earnest attention. I may say that the lamp described is now at work and has been since March last.

The past year has not been prolific of new inventions; and, consequently, I have not many remarks to make. But I cannot let the present opportunity pass without reverting to the very valuable paper read by Mr. Valon, of Ramsgate, before the Gas Institute at its last meeting. Continuous purification in covered vessels has been the dream of engineers for a considerable time; and I consider that Mr. Valon has almost achieved this very desirable object. You are all in possession of his arguments and statistics; and, therefore, there is no necessity to recapitulate them. I may say, however, that I have no doubt those of you who anticipate increasing your purifying area, will very carefully consider the Valon-Brin oxygen process of purification.

Standard sizes for all gas works stores have been advocated by this and kindred Associations; and I believe some expression of opinion has been given that our respected Secretary should communicate with other Associations with the view to bring about this very desirable object. I do not know whether anything has been done; but I do recognize the difficulty we should meet in trying to have one uniform size of retort. It is generally known that there are nearly as many sizes of clay retorts as there are gas managers—each manager thinking his own the best. He may be perfectly right as far as his requirements go, but altogether wrong so far as his neighbor is concerned. Who is to fix this standard? He would be a bold man who would rise and say it shall be so and so. The question, in my opinion, can only be solved by constructive engineers of large practical experience, who are able, from their own observations, to give standard sizes of retorts. We have a gentleman among us who has done good service to this Association, who is ever ready to give us a helping hand, and whose opinion we very much value. He might suggest a standard size of retort. Even if he did, however, I am not sure that it would be adopted by every country manager. It has been argued that we shall obtain our materials cheaper if greater uniformity in sizes prevails; and doubtless there is some truth in such an assumption. But in face of the difficulties of position and situation, I am afraid we shall have to submit to the present state of affairs until "Time's soothing hand" or engineering skill shall have removed difficulties.

Referring to other stores than retorts, I think we have not much to complain of. There was a time, in my own memory, when, for instance, a ⅝-inch bolt from one firm was quite a different thing from a ⅝ inch bolt from another firm. Happily, with the name of Whitworth, this anomaly has disappeared. Purchase iron tubes to-day from any firm in the kingdom, and they will follow each other as easily as they would do consecutively from one maker. The same thing applies to cast iron mains. Even meter unions from several different makers are interchangeable; although some of the meter makers would do well to keep this matter more prominently before them.

I will not occupy your time by discussing the question of large and small ascension pipes, or the various forms of condensers and scrubbers now in use, as these subjects have been thrashed out times innumerable. But I should like to briefly refer to the matter of sulphate of ammonia apparatus. I feel sure we have something more to learn on this very interesting subject. Between the old Coffey still and the Feldmann's process, although there is a wide difference, there is yet much in common. The Feldmann's process appears to be in favor just now. The apparatus at the works of the Doncaster Corporation was locally constructed, and is of small dimensions, but capable of distilling 100 gallons of liquor per hour, and freeing it of ammonia to ½ oz. per gallon. It is easy of manipulation, requires but little attention, and is cheap and sure; and if I were extending I would keep to the same sized still, and increase the number as I would in retorts. I hope some member of this Association will favor us with a paper on this subject at our next spring meeting.

About gasholder construction, I have little to say. This subject has been exercising the minds of engineers for some considerable time. I had the pleasure of seeing in Doncaster last year the model of Mr Gadd's system. It was first exhibited here to the members of the Manchester District Institution of Gas Engineers. At that time I, in common with other managers present, was much pleased with the originality and simplicity of the design; and with the absence of cumbrous columns and upper guiding. But in looking over the pages of the *Journal of Gas Lighting* last week I saw an elaborate illustration of Gadd and Mason's improvements in the construction of gasholders; and I must confess that my ideas of simplicity received, to say the least of it, a shock. My opinion upon this subject may not be worth much; but it appears to me that the difference in cost between the old upper gearing, which has become cheap, strong and light, and the new arrangement, with its multiplicity of spur wheels and revolving shafts and spiral gearing, cannot be material, while its simplicity has vanished. I have very vivid recollections of leaving a very cosy fireside on cold winter nights to set free one of the late John and James Malam's rack-and-pinion guided gasholders, and I prefer not to renew that experience. When I compare these appliances I am inclined to ask whether there is anything new under the sun. I bring this matter before you as worthy of thought.

And now, gentlemen, in conclusion, allow me to say how much pleasure I have at seeing so many of my professional brethren in Doncaster. We are all engaged in one common cause—that of supplying gas for artificial lighting and as fuel, at as low a price as possible. We are, as I have shown you, surrounded by competitors in one important part of the field—namely, that of public and private lighting. I repeat that we have nothing to fear so far as the loss of business is concerned; but there may be a change of venue for the sale of the manufactured article. That, however, is yet a matter for the future to decide. Meanwhile we ought to strive to make gas still more popular than it has ever been; and while we should zealously cultivate that branch of business in which we have so long reigned supreme, we should, octopus-like, spread out our arms and fasten upon every other part of the field where gas is required, whether it be for lighting, for heating, for cooking, or for driving engines. With a fair share of the public patronage in each of these departments, our industry will not only maintain its present powerful position, but will increase in importance and stability.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Oct. 10, 1889.

Electric Light in Practice.—Water Gas Before the Iron and Steel Institute.—Gas and Ventilation at Paris.—Mr. J. H. Cox, on Gas and Ventilation.

It is probable that, in the course of a few months, some practical information as to the cost of working and distributing electricity for lighting, on the large scale, will be forthcoming. At any rate, several ventures, both in London and also in our principal towns, are in progress for working this system on a regular commercial scale; but whether the extreme reticence as to the publication of actual working statistics, that has been a remarkable feature in connection with previous attempts at practical electric lighting, will still be adhered to, remains to be seen. Meanwhile some information that has been published at Stafford is of an interesting character. It appears that the town council of that town, having the question of electric lighting under consideration, very wisely

referred to their own town clerk, and to the Engineer of their gas works—Mr. J. Ferguson Bell—for a report on the subject. The former gentleman addressed himself to the legal aspect of the case, and Mr. Bell gives his opinion on three important points. These are: (1) What is the minimum demand for electric lighting that would justify the establishment of works of supply, and within what area? (2) What is the minimum capital outlay that would be necessary? (3) What is the minimum price of supply that would be remunerative, and what would be the equivalent price of gas? In answer to the first question, Mr. Bell considers that electric light works should not be established unless there is a probability of at least 2,000 sixteen-candle incandescent lamps being required within the area of supply, and an actual guarantee for 1,200 such lamps for a period of two years at a fixed price. The cost of the necessary plant, exclusive of land (the corporation possess a suitable site), he puts at £14,500. This includes two boilers 30 ft. long by 7½ ft. diameter, three 100-horse power high-pressure compound steam engines, three alternating current dynamo machines (each capable of supplying 1,056 sixteen-candle incandescent lamps), 150 transformers, charging and distributing mains, regulating and testing instruments, and an allowance for contingencies. It will be seen that this includes a reserve of engine and dynamo power in case of contingencies. As regards the cost of electricity as compared with gas, Mr. Bell remarks that when the former is used in 16-candle incandescent lamps, and the latter in ordinary burners, the price charged per unit (1,000 watts) multiplied by 10 gives the cost of 1,000 cubic feet of 16-candle gas. The prices now charged by electric supply companies vary from 7½d. to 8d. per unit, and this is equivalent to gas at 6s. to 6s. 8d. per 1,000 cubic feet. This does not include charges for rent of meter, converter, safety fuse, switch, etc., which range from £2 10s. to £7 per annum, according to the number of lights in use, and therefore represents a considerable addition to the "electricity" bill. Mr. Bell observes that electric meters are costly, and believes that a meter well adapted for general use has yet to be invented. He therefore recommends, in the first instance at any rate, a definite price per lamp per quarter. A 16-candle incandescent lamp, charged by meter at 7d. per unit, would cost £2 12s. per annum of 1,500 hours actual use; and a gas light under similar conditions would cost £1 2s. 6d. with gas at 3s. per 1,000 cubic feet. The report concludes with an estimate of working expenses, showing that 1,200 lamps, at a contract price of £2 each, would yield a moderate profit, and 2,000 lamps on similar terms, a handsome profit. According to Mr. Bell's figures, 2,000 lamps or upwards could be supplied at a price equivalent to 4s., or 4s. 6d., per 1,000 cu. ft. of gas.

But Mr. Bell's estimate is deficient in one important point. In the distribution of gas we have the item of "unaccounted-for" gas to encounter. This ranges from 2 up to 20 per cent., according to circumstances. I have not been able to ascertain whether, in the distribution of electricity, there is anything in the way of "unaccounted-for" electricity. It is easy to take 200 horse power and divide it out between 2,000 incandescent lights, extended over an area of perhaps 1,000 yards square. But what I want to know is, assuming such a plant to be at work, would all the lights far and near come up to the 16-candle pitch? Would it not be necessary to do work with a considerable excess of horse power, say more like 300 than 200, to secure such a result? To put the question in another way, is it possible in practice to secure perfect insulation throughout a system embracing several miles of conducting wire of various sizes?

A paper was read at the meeting of the Iron and Steel Institute, at Paris, on the subject of Water Gas, by Sir Lowthian Bell, who is one of our highest authorities on all matters pertaining to metallurgy. While drawing attention to the value of water gas for special purposes where intense temperatures were needed, he was by no means positive as to its general utility for heating and lighting. Mr. Sampson Fox, who has been a principal character in the recent water gas financial operations in England, attempted to make matters better in regard to the house-to-house distribution of that mixture, but failed in a remarkable manner. Mr. Fox has already claimed great economy in distribution by applying an initial pressure of 600 pounds per square inch, and thus getting as much gas through a wrought iron pipe of 1¼-inch bore as is supplied by a 36-inch gas pipe in the ordinary way. But on suggesting this brilliant notion he was at once met by awkward questions as to the amount of power required for compression, and other practical details. He was equally unfortunate in regard to the dangers of leakage, which he disposed of by the suggestion of thoroughly tight gas fittings, and a little volatile oil to odorize the gas. It was generally understood that a higher pressure at the point of consumption was required for water gas than for coal gas. Sir Frederick Abel thought that great caution would have to be exercised before water gas could be satisfactorily employed for indoor illumination. Although an experienced gasfitter might secure "thoroughly tight" fittings, he was doubtful as to the possibility of obtaining such in the ordinary way, even with carefully overhauled gasfittings, so as to admit of water gas being used as a substitute for coal gas. An ounce of fact is worth a bushel of theory, and if Mr. Fox would take a gasfitter of average intelligence to the premises of any ordinary gas consumer, substitute an accurate test meter for the one in general use, and then set the man to work to make the fittings "thoroughly gas tight," so that the pointer should not move, say, 1-1000th part of a cubic foot in five minutes, his knowledge as to the possibilities of securing that result would be greatly advanced. In many of our towns, thanks to the use of cheap gasfittings, it is supposed that the use of gas is necessarily attended by a taint of escaping gas about the house, and medical gentlemen have consequently formed a prejudice against its use in ordinary sitting and bedrooms. If this is the case with coal gas containing 5 per cent. of carbonic oxide, what would they say about water gas containing 25 to 30 per cent. of carbonic oxide, and supplied at a higher pressure?

The current number of the *Journal des Usines a Gaz* contains an interesting description, illustrated with well executed drawings (one of which is printed in colors) of a system of ventilation in connection with the gas lighting adapted to one of the show rooms of the Paris Gas Company, as arranged by M. Levy. It is the more interesting as having been erected in an existing building, and so far as one may judge from the drawings, the premises consist of a large double-fronted shop, situated in a principal thoroughfare. The burners used are of the Cromartie or of the Wenham type, and comprise 12 single burners and a cluster of 5. The products of combustion are conveyed into flat rectangular tubes of galvanized iron laid just below, but not touching the ceiling. The awkward effect that would be created by leaving these tubes naked is obviated in a most ingenious manner. The whole of the ceiling is mapped out into an elegant design of panelling, the projecting members of which are so adapted as to conceal the iron tubes. They form, in fact, tight wooden cases to receive the same, and leave a clear space all round, thus avoiding any danger from excessive heating. The tubes pass from each burner into one main flue, and finally to an up-cast shaft. At the base of the shaft is a chamber containing a cluster of atmospheric gas burners, which can be lighted during the day-time when the other burners are not required, and serve to maintain a draught in the chimney, and thus to draw off air from the apartment through the recuperator burners, securing proper ventilation and in fact performing the same work that is effected by the lighting burners when they are in use. Suitable provision is made for the entrance of fresh air. This system could be readily adapted to existing buildings, or it might be erected as a temporary arrangement at exhibitions of gas apparatus, etc.

It happens that the same subject was dealt with by Mr. J. H. Cox, of Sunderland, in a paper read before the North of England Association of Gas Managers, a few days before the publication of the magazine just referred to. Mr. Cox's paper bears the attractive title of "Gas Popularization," and the portion that is devoted to the important subject of ventilation describes the results of some original experiments conducted in ordinary rooms with gas fires, recuperative burners and simple appliances such as could be readily fitted up at an inconsiderable cost. Mr. Cox shows how an ordinary chimney may be utilized in this connection simply by letting in an air brick or other convenient communication at the ceiling level. The draught in the chimney, assisted by the warmth of the air at that part of the room, maintains a continual efflux, thus removing the products of combustion and respiration from the aparment. Of course a proper inlet for fresh air must be provided. The figures given prove conclusively that coal gas may be applied, in an economical manner, as an efficient agent for performing the threefold duty of lighting, warming and ventilating our dwelling houses. And it is to be hoped that their publication will assist in rousing these interested in the sale of gas, who have hitherto been satisfied to lay quietly by and allow electricians and sanitary enthusiasts to abuse gas as a product of poisonous vapors, to a sense of the important future that awaits the application of gas as a ventilating agent; and to show that the advantages afforded by gas may be secured, not only with absolute removal of the products of combustion, but with perfect ventilation also, an advantage that can never be afforded by the electric light. That some information is badly needed on the subject by the public is continually made evident. Only the other day a councillor in one of our important Western cities, speaking in public, said that the "impurities in gas had slain their thousands and the explosions their ten thousands." This was probably intended as an eloquent and metaphorical way of informing the public that gas is both poisonous and dangerous, when not used with ordinary reasonable care or intelligence.

[Official Report.—Revised by the Secretary.]

Seventeenth Annual Meeting of the American Gas Light Association.

Held at Baltimore, Md., Oct. 16, 17 and 18, 1889.

First Day—Morning Session.

The American Gas Light Association held its Seventeenth Annual Meeting at Concordia Hall, Baltimore, Md., October 16th and 17th, 1889. The first session was called to order by the President, Mr. A. B. Slater, of Providence, R. I., Wednesday, the 16th of October, at 10:30 A. M. The Secretary, Mr. C. J. R. Humphreys, being absent on account of sickness, Mr. William Henry White was elected Secretary *pro tem.* On motion of Mr. Harbison the reading of the minutes of the last annual meeting was dispensed with, the same having been published in the gas papers.

Calling the Roll.

Upon the call of the roll the following members were found to be in attendance:

Adams, H. C., Philadelphia, Pa.
Adams, Wm. C., Richmond, Va.
Addicks, J. Edward, Phila., Pa.
Allen, Augustus L., Poughkeepsie, N. Y.
Andrew, Jno., Chelsea, Mass.
Atwood, H. A., Plymouth, Mass.
Bartlett, E. L., Baltimore, Md.
Baumgardner, John H., Lancaster, Pa.
Baxter, Isaac C., Detroit, Mich.
Baxter, Robert, Halifax, Nova Scotia.
Baxter, Wm. H., Petersburg, Va.
Betts, Edward, Wilmington, Del.
Bierce, Frank, Memphis, Tenn.
Bill, George D., Malden, Mass.
Blodget, Chas. W., Brooklyn, E. D., N. Y.
Boardman, A. E., Macon, Ga.
Boardman, Henry, Bangor, Me.
Borgner, Cyrus, Philadelphia, Pa.
Bredel, Frederick, New York, N. Y.
Brown, E. C., New York, N. Y.
Bush, Jno. S., New York, N. Y.
Byrne, Thos. E., Brooklyn, N. Y.
Cartwright, Matt., Rochester, N. Y.
Cartwright, Wm., Oswego, N. Y.
Chadwick, H. J., Lockport, N. Y.
Chambers, John S., Trenton, N. J.
Chollar, Byron E., Topeka, Kan.
Clark, Walton, Philadelphia, Pa.
Coggshall, H. F., Fitchburg, Mass.
Collins, A. P., New Britain, Conn.
Connelly, J. S., New York, N. Y.
Connelly, T. E., New York, N. Y.
Cornell, Thos. C., Yonkers, N. Y.
Cowdery, Ed. G., Milwaukee, Wis.
Crafts, David W., Northampton, Mass.
Cressler, A. D., Fort Wayne, Ind.
Curley, Thomas, Wilmington, Del.
Cushing, Oliver E., Lowell, Mass.
Daly, David, Jersey City, N. J.
Davis, Frederick J., Waltham, Mass.
Dell, Jno., St. Louis, Mo.
Denniston, W. H., Pittsburg, Pa.
Diall, M. N., Terre Haute, Ind.
Dickey, Charles H., Baltimore, Md.
Dickey, R. R., Dayton, Ohio.
Down, Wm. H., New York, N. Y.
Faben, Charles R., Jr., Toledo, Ohio.
Findlay, J. H., Ogdensburg, N. Y.
Flemming, Dudley D., Jersey City, N. J.
Floyd, Fred W., New York, N. Y.
Floyd, Henry E., New York, N. Y.
Fodell, Wm. P., Philadelphia, Pa.
Fowler, John, Philadelphia, Pa.
Gardner, James, Jr., Pittsburg, Pa.
Gardner, William, Pittsburg, Pa.
Gates, Frederick Wm., Hamilton, Ontario.
Gibbs, W. W., Philadelphia, Pa.
Gilbert, Thomas D., Grand Rapids, Mich.
Glasgow, Arthur G., Kansas City, Mo.
Goodwin, W. W., Phila., Pa.
Gordan, J. J., Cincinnati, Ohio.
Graeff, Geo. W., Jr., Phila., Pa.
Gribbel, John, New York, N. Y.
Griffin, John J., Phila., Pa.
Hallett, J. L., Springfield, Mass.
Hambleton, F. H., Baltimore, Md.
Hanford, L. C., Norwalk, Conn.
Harbison, John P., Hartford, Conn.
Hayward, Thos. J., Baltimore, Md.
Helme, Wm. E., Philadelphia, Pa.
Hookey, George S., Augusta, Ga.
Hoover, C. E., Winchester, Va.
Hopper, Thos. C., Germantown, Pa.
Hopper, Wm. H., Germantown, Pa.
Humphreys, Alex. C., Phila., Pa.
Humphreys, C. J. R., Lawrence, Mass.
Jones, Edward C., So. Boston, Mass.
Krumholz, Joseph, Buffalo, N. Y.
Kuehn, Jacob L., York, Pa.
Lamson Charles D., Worcester, Mass.
Landsen, Thomas G., Washington, D. C.
Leach, Henry B., Taunton, Mass.
Learned, E. C., New Britain, Conn.
Learned, Waldo A., Newton, Mass.
Lindsley, Edward, Cleveland, O.
Littlehales, T., Hamilton, Ontario.
Loomis, Burdett, Hartford, Conn.
Lynn, J. T., Evansville, Ind.
Mayer, Frederick, Baltimore, Md.
McCleary, Alex. J., Phila., Pa.
McDonald, Wm., Albany, N. Y.
McElroy, Jno. H., Pittsburg, Pa.
McIlhenny, John, Phila., Pa.
McMillin, Emerson, St. Louis, Mo.
Milsted, Wm. N., New York City.
Monks, Richard J., Boston, Mass.
Mooney, Wm., New York, N. Y.
Nettleton, Chas. H., Birmingham, Conn.
Newell, Jno. W., New Brunswick, N. J.
Nute, Jos. E., Jersey City, N. J.
O'Brien, Wm. Jno., Phila., Pa.
Odiorne, Fred. H., Boston, Mass.
Page, Geo. Shephard, New York, N. Y.
Park, Wm. K., Philadelphia, Pa.
Parrish, Wm., Seneca Falls, N. Y.
Pearson, Wm. H., Toronto, Ont.
Perkins, Jas. D., New York, N. Y.
Pratt, Edw. G., Des Moines, Iowa.
Prichard, Chas. F., Lynn, Mass.
Quinn, A. K., Newport, R. I.
Ramsdell, Geo. G., Vincennes, Ind.
Rogers, James F., Jamaica Plain, Mass.
Rowland, Chas. L., Brooklyn, N. Y.
Rowland, Wm. L., Phila., Pa.
Rusby, Jno. M., Jersey City, N. J.
Russell, D. R., St. Louis, Mo.
Scriver, J. F., Montreal, Canada.
Shelton, Fred'k H., Phila., Pa.
Sherman, F. C., New Haven, Conn.
Sisson, Frank N., Albany, N. Y
Slater, A. B., Providence, R. I.
Slater, A. B., Jr., Providence, R. I.
Smallwood, James B., Baltimore, Md.
Smith, Marcus, Wilkes Barre, Pa.
Smith, Orlando F., Washington, D. C.
Smith, Robert A. C., N. Y. City.
Snow, W. H., Holyoke, Mass.
Spaulding, Chas. F., Waltham, Mass.
Spaulding, Chas. S., Brookline, Mass.
Starr, James M., Richmond, Ind.
Stein, E., Philadelphia, Pa.
Stiness, Samuel G., Pawtucket, R. I.
Taber, Robert B., New Bedford, Mass.
Thomas, Joseph R., New York, N. Y.
Thompson, James D., St. Louis, Mo.
Townsend, S. S., New York, N. Y.
Tufts, Nathaniel, Boston, Mass.
Turner, Thomas, Charleston, S. C.
Vanderpool, Eugene, Newark, N. J
Wagner, Louis, Philadelphia, Pa.
Warmington, G. H., Cleveland, Ohio.
Watson, Cliarles, Camden, N. J.
Weber, Oscar B., New York City.
White, Wm. Henry, New York, N. Y.
Wilcox, H. K., Middletown, N. Y.
Wood, Gideon, New Bedford, Mass.
Wood, Walter, Philadelphia, Pa.
Young, John, Allegheny City, Pa.
Young, Robert, Allegheny, Pa.

Report of Council on Last Year's Applications for Membership.

At the meeting at Toronto, last year, there was some question as to the application of the new Constitution to the elections of members that were then held, and it was referred to the Council to take decisive action; and by your vote the Council were instructed to make valid the elections, if there was not an election, by electing those gentlemen to membership. The Council, therefore, present this report:

To the Members of the American Gas Light Association: In accordance with the vote passed at the last meeting, your Council recommend that the election of a year ago of the following gentlemen be confirmed:

Active.

Chadwick, H. J., Lockport, N. Y.
Thomas, Mark B., Dundas, Ont.
Stoddard, C. H., Brooklyn, N. Y.
Pearson, W. H., Jr., Toronto, Ont.
Higby, W. R., Bridgeport, Conn.
Slater, A. B., Jr., Providence, R. I.

Associate.

Wilson, W. I., New York, N. Y.
Norton, H. A., Boston, Mass.
Persons, F. R., Chicago, Ill.
Van Wie, P. G., Cleveland, Ohio.
Wright, W. S., Chicago, Ill.

For the Council,
C. J. R. Humphreys, Sec'y.

On motion of Mr. Stiness the recommendation of the Council was approved, and the election of the members named confirmed.

Election of New Members.

The Secretary—The Council further report their approval of applications for membership, as follows:

The Council having approved of the following applications, respectfully submit them to the Association for action:

Active.

Anderson, Wm., Marlboro, Mass.
Eichbaum, F. H., San Francisco, Cal.
Vail, R. B., Rahway, N. J.
Forbes, Jas., Chattanooga, Tenn.
Welsh, Wm. L., Oswego, N. Y.
Harper, Geo. H., Fall River, Mass.
Norris, Rollin, Jersey City, N. J.

Littleton, A. W., Quincy, Ill.
Spaulding, W. F., Clinton, Mass.
Butterworth, Irvin, Columbus, O.
Evans, Chas H., Jackson, Mich.
Bradley, Fred. L., New York City.
Wood, Wm. A., Boston, Mass.
Bailey, Charles B., Washington, D. C.
Franklin, S. J., Warren, Pa.
McCutcheon, Jas., Allegheny, Pa.
Lysle, Addison, Pittsburgh, Pa.
McDonald, Wm., Phila., Pa.
Miller, A. S., Omaha, Neb.
Egner, Frederic, St. Louis, Mo.
Hostetter, D. Hubert, Pittsburgh, Pa.
Slaney, H. C., New York City.
Cornell, A. B., Youngstown, O.
Carroll, Francis, New Orleans, La.
Mitchell, K. M., St. Joseph, Mo.

Associate.

Logan, Wm. J., Brooklyn, E. D., N. Y.
Barrows, W. E., Phila., Pa.
Rice, F. B., New York City.
Oakman, Richard N., Greenfield, Mass.
Sumner, Robert N., Phila., Pa.
Ossius, George, Detroit, Mich.
Conant, Ed., New York City.
Crane, Wm. M., New York City.
Stratton, S. S., Chicago, Ill.
Walsh, R. D., St. Louis, Mo.

The President—What action will you take with regard to these applications for membership? The ordinary way is to authorize the Secretary to cast the ballot of the Association.

Mr. Harbison—I move that the acting secretary cast the ballot of the Association for the election of the gentlemen whose names have been read.

The President—If there is no objection that will be done. I will appoint Mr. Stiness teller to receive and report on the vote.

The Secretary—If there is no objection I will cast the unanimous vote of the Association for the election to membership of the gentlemen whose names have been read.

Mr. Stiness—I find that the ballot is unanimous, and that the gentlemen named are elected members of the American Gas Light Association.

The President—If the gentlemen whose names have been read, and who have been elected members of the Association, are present, they will please rise. [The members were introduced.]

The next business is the reading of the Report of the Council on the workings of the Association during the last year, which will be read by the Secretary.

REPORT OF COUNCIL.

BALTIMORE, MD., October 15th, 1889.

To the Members of the Association:

Your Council would respectfully offer the following Report on the work of the Association for the past year:

More than the ordinary amount of routine work has been performed during the year. Volume 8 of the proceedings, comprising the record of the 1887 and 1888 meetings has been published in book form, similar to the volumes previously published. There has also been published a General Index to all the volumes of the Proceedings, including that last issued. This involved, first, the preparation of an index to Volume One, which was not indexed originally.

In the list of members annexed to Volume 8 will be found dates showing when each person was elected to membership. The preparation of these dates has involved a great deal of research among the early records of the Association, and the task was the more difficult because at the outset the membership was made up of gas companies and not individuals, then, later, these companies named their representatives, who were thereafter considered members.

The Council has also made arrangements to carry out the wishes of the Association by having the papers printed in advance of each meeting. We regret that each year a few of the papers are held back so long as to prevent their being printed before the Convention.

The permanent gold badge prepared under the direction of the Badge Committee has been sent to the members within the last few weeks. These were all sent out by registered mail to ensure their safe transmission.

The Council has approved the following papers to be read during the meeting.

"Fuel Gas," by Walton Clark; Care and Operation of Gas Holders," by C. L. Rowland; "Illuminating Water Gas—Past and Present," by F. H. Shelton; "Leakage and Condensation," by E. C. Jones; "Purification of Gas from Kansas Coals," by B. E. Chollar; "Conduct of the Electric Light Business in Connection with the Gas Industry," by W. H. Pearson; "Advantages of Supplying a Mixture of Coal and Water Gas," by T. G. Lansden; "Some Thoughts on Fuel Gas, Induced from Practical Experience in the Distribution of Natural Gas," by John Young; "Gas Calorimetry," by Prof. E. G. Love.

The Council hoped to have been able to present a paper, from Mr. H. C. Adams, on "American Gas Coals," but we regret that ill health and press of many duties have prevented that gentleman from preparing his essay.

The Council have appointed the following gentlemen to serve as the Committee on Nominations, viz.:

Chas. H. Nettleton, Birmingham, Conn.; Ed. Lindsley, Cleveland, O.; D. H. Geggie, Quebec, Canada; Geo. S. Hookey, Augusta, Ga.; Ed. G. Cowdery, Milwaukee, Wis.

The duty of this Committee is to bring before you a list of nominees for officers to serve for the ensuing year:

The Council recommend that Edmund T. Davis be appointed the Official Stenographer of the Association.

The Council recommend that hereafter the Association takes its own report of the meetings (as at present) and furnish the gas papers with a copy, at the expense only of the cost of making said copies.

For the Council,
C. J. R. HUMPHREYS, Secy.

The Finance Committe have approved the accounts of the Treasurer, as per report attached.

For the Council,
C. J. R. HUMPHREYS, Secy.

REPORT OF FINANCE COMMITTEE.

To the Council: Your Finance Committee have examined the books and vouchers of the Secretary and Treasurer, C. J. R. Humphreys, for the year ending September 30, 1889, and find the same to be correct.

WM. HENRY WHITE.
A. E. BOARDMAN,
GEO. G. RAMSDELL. } Finance Committee.

On motion of Mr. Stiness, seconded by Mr. Harbison, the Report of the Council was accepted and the recommendations therein made adopted.

REPORTS OF TREASURER AND SECRETARY.

The following reports of the Treasurer and Secretary, for the year ending September 30, 1889, were, on motion, accepted and placed on file:

Treasurer's Report.

Receipts.

Dues for year of 1886	$15.00	
" " 1887	70.00	
" " 1888	210.00	
" " 1889	1,265.00	
" " 1890	500.00	
Initiation fees	270.00	
Sale of books	19.25	
Account of Stenographic Report of Toronto Meeting	96.84	
Interest	104.56	
Total	$2,550.65	
Amount brought forward from last year	2,862.95	
		$5,413.60

Expenditures.

Expenses Toronto Meeting	$192.63	
Salary of Sec. and Treas	600.00	
Printing of Stationery	221.66	
Stamped Envelopes, Stamps and Sundries	760.17	
Expenses of Council and Committee Meetings	178.88	
Printing Volume 8 and General Index to Vols. 1 to 8	1,140.00	
Badges—450—also, samples	1,832.00	
Expenses of Reporting Toronto Meeting	290.50	
	5,215.84	
Amount carried forward to next year	197.76	
		$5,413.60
Due from Members	$1,785	

Secretary's Report.

Number honorary members on roll, Oct. 1, 1888	7
Died during the year	1
Number on roll Oct. 1, 1889	6

Number active members on roll Oct. 1, 1888	333
Admitted Oct. 1, 1888	22
Total	355
Resigned during the year	8
Dropped " " "	4
Died " " "	5
Number on roll Oct. 1, 1889	338
Total	355

Associate.

Associate members admitted Oct., 1888.....5
Number on roll, Oct. 1st, 1889.....5

Deceased Members.

Honorary.

R. P. Spice,.....London, England.

Active.

John Cartwright.....Poughkeepsie, N. Y.
C. F. Maurice.....Sing Sing, N. Y.
F. D. Kingsbury.....Corning, N. Y.
C. H. Nash.....St. Joseph, Mo.
J. H. McDougall.....Hornellsville, N. Y.

REPORTS OF SPECIAL COMMITTEES.

The President—The next business is the reading of the reports of special committees. Has any Chairman of a special committee a report to make?

REPORT OF COMMITTEE ON BADGES.

Mr. Nettleton—On behalf of the Committee on Badges, I will say that we have made our report, and that the badges are in the hands of the members of the Association. When we reported a year ago, the committee agreed that designs should be obtained from several manufacturing jewellers. A number of designs were obtained, and we tried to agree upon one; but, finally, thinking that we could get more satisfactory results if we could judge from the badges themselves, we had a number of sample badges made, and after a good deal of effort and time the committee were able to agree on a certain badge. This was shown to the President and Secretary of the Association, and they agreed with the committee that it was perhaps as well as we could do for the money, and the badges were ordered. They cost $4.50 each, and the committee hope that the Association are satisfied with what they have done.

Mr. Harbison—I move that the report of the committee on badges be accepted and the committee discharged, with the thanks of the Association for the thoroughness with which they have attended to their duties. [Adopted.]

REPORT OF COMMITTEE ON STANDARD UNIONS.

Mr. Down—As Chairman of the Committee on Standard Unions I will state that the committee are prepared to make a report. We have had several meetings of the committee, and have had a great deal of trouble in trying to agree upon some standard. We have finally agreed upon the standards, and trust that our recommendation will meet with your favor. Mr. Goodwin will read the Report of the Committee.

Mr. Goodwin read as follows:

The Committee on Standard Unions beg leave to present the following report:

At the last meeting of the Association, held in the city of Toronto, Standards for 3, 5 and 10-lights were adopted by the Association, and the Committee were continued with instructions to report further Standards at this meeting, and now present the following sizes for your consideration and adoption, viz.:

20-light, $11\frac{1}{2}$ threads; diam. of screw, $1\frac{53}{64}$; diam. of tail piece, $1\frac{54}{64}$; diam. of nose, $1\frac{50}{64}$.

30-light, $11\frac{1}{2}$ threads; diam. of tail piece, $1\frac{37}{64}$; diam. of nose, $1\frac{33}{64}$; diameter of thread, $2\frac{8}{64}$.

45-light, $11\frac{1}{2}$ threads; diam. of tail piece, $1\frac{50}{64}$; diam. of nose, $1\frac{45}{64}$; diam. of thread, $2\frac{1}{64}$.

60-light $11\frac{1}{2}$ threads; diam. of tail piece, 2"; diam. of nose, $1\frac{58}{64}$; diam. of thread, $2\frac{18}{64}$.

80-light, $11\frac{1}{2}$ threads; diam. of tail piece, $2\frac{8}{64}$; diam of nose, $2\frac{5}{64}$; diam. of thread, $2\frac{10}{64}$.

100-light, $11\frac{1}{2}$ threads; diam of tail piece, $2\frac{21}{64}$; diam of nose, $2\frac{14}{64}$; diam. of thread, 3".

Your committee would also report that they have had prepared "Standard Gauges" for 3, 5 and 10-light meters, and each manufacturer now possesses one set each, and have presented a set to the Association which have also been deposited with the Secretary for reference. These guages were manufactured by the Pratt-Whitney Co.

Your committee would also state that since the adoption of the 3, 5 and 10-light Standards orders for meters with Standard Unions have not been received as freely as was expected. We, therefore, respectfully suggest that the 1st day of March, 1890, be named as the date from and after which all meters ordered shall be furnished with Standard Unions adopted by this Association, unless expressly ordered otherwise.

All of which is respectfully submitted,

W. H. DOWN, Chairman.

Mr. Goodwin—If this report is adopted, the members of the different manufacturing firms are prepared to furnish the Association with the standards, and they would like to know your pleasure with regard to other sizes.

The President—You have heard the report of the committee on standard unions; what will you do with it?

Mr. Harbison—I move that the report of the committee on standards be accepted and approved, and that the recommendations be adopted by this Association.

Mr. Walton Clark—I wish to add to that motion that we give the committee a hearty vote of thanks for the pains they have taken, and the expense they have been to, in order to provide us with standard unions. Every man who has ever set a meter knows the value that uniform standards will be to the Association. I, therefore move a hearty vote of thanks to the committee.

The President—You have heard the motion of Mr. Harbison, and the remarks of Mr. Clark.

Mr. Harbison—It should be understood that, as their work is not completed, the committee are to be continued in office My motion therefore is that we accept the report of the committee as made, and that the committee be continued in order that they may carry on and complete the work that they have undertaken. [Adopted.]

ELECTION OF OFFICERS.

Mr. Nettleton—The committee on nominations have had but two meetings, but they have agreed to recommend the following gentlemen as officers of the Association for the ensuing year:

For President—Emerson McMillin, St. Louis, Mo.

For Vice Presidents—Jno. P. Harbison, Hartford, Conn.; Wm. H. White, New York; A. E. Boardman, Macon, Ga.

Sec. and Treas.—C. J. R. Humphreys, Lawrence, Mass.

Member of Council for one year—B. E. Chollar, Topeka, Kansas.

Members of Council for two years—S. G. Stiness, Pawtucket, R. I.; Walton Clark, Philadelphia, Pa.; Chas. R. Faben, Jr., Toledo, O.; Thos. G. Lansden, Washington, D. C.

The President—What will you do with the report of the Committee on Nominations?

Mr. White—I move that it be accepted, and that Col. Thomas cast the ballot of the Association for the election of the officers, as named.

Mr. Thomas—I cast the ballot of the Association for the gentlemen named as officers for the coming year.

The President—By unanimous vote the officers named are elected, and they are declared to be the officers of the Association for the ensuing year. Is Mr. McMillin present?

Mr. Egner—Mr. McMillin told me that he could hardly hope to be here, as his family are going to Europe to stay for some time; but that he would get here if he possibly could.

Mr. Harbison—I move that the Secretary be directed to telegraph to Mr. McMillin and announce to him his election as President of the Association for the coming year. [Agreed to.]

The President then read the following address:

PRESIDENT'S ADDRESS.

Gentlemen of the American Gas Light Association:—We come to this, our Seventeenth Annual Meeting with mutual congratulations that the great industry which we represent still remains in a prosperous condition throughout the country, notwithstanding the fact that we have had to meet such competition in the supplying of artificial light as has never been known in the history of the business.

There are very few companies whose books do not show an increase in the quantity of gas distributed, and this increase is generally the greatest in the larger cities where competition is the most active. This fact alone furnishes ample evidence that illuminating gas of good quality still holds the confidence of our consumers, and that no other illuminating agent is yet able to furnish an equal quantity of light for a given sum of money, and at the same time be as sure and safe a depend

ence to the public, and pay a fair return upon the capital which is necessary to carry on the business. From these facts we would naturally expect to see renewed confidence in the future and permanency of the business, and this is shown in the activity which we everywhere see in the expenditure of large sums of money for the enlargement and extension of the business, by the construction of new and improved apparatus and machinery, larger gasholders, mains, etc. New and improved apparatus and machinery, with better facilities and better management, result in reduced cost of production, which enables us to reduce the selling price of gas, and that means increased sales, which, in turn, adds another element of economy in cost of manufacture. A gas company that means to hold its present business and increase it, will not be too slow in adopting improved methods and machinery when economy of manufacture is sure to result from their use.

One of the objects of this Association is to facilitate the interchange of information and knowledge among the members which may enable the companies to take advantage of improvements in manufacture. To be more explicit, our Constitution reads, "The object of this Association shall be the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction and management of gas works and the manufacture, distribution and consumption of gas. The establishment and maintenance of a spirit of fraternity between the members of the Association, by social intercourse and by friendly exchange of information and ideas on the before mentioned subject matters, the inducement and extension of more cordial and friendly relations between the manufacturers of gas and their patrons, based upon the mutuality of interests."

The public may look upon this Association as being a gigantic combination of monopolists, a sort of Trust, whose sole object is to devise some scheme to bull the price of gas throughout the country. On the contrary, the object and nature of this Association preclude the possibility of a member taking any action or doing anything which in any manner by such act can bind a single company represented here. It is not an Association of gas companies, but of individuals, and no member is authorized or empowered by his board of directors to perform any act as a member of this Association to bind the company which he represents. At the most, he can only recommend to his directors that a certain action be taken or a certain policy be adopted, not because of any action of the Association, but solely because of information and knowledge acquired by attendance at our meetings.

In the early days of gas manufacture in this country we had no educated or experienced gas engineers or managers, and it was quite natural that the forms and regulations of older countries should be adopted for guidance. "Cast iron rules and regulations" were generally adopted and observed to the letter, and when the officer, whose duty it was to see that the rules and regulations were carried out, happened to be a person of a morose nature, without a pleasing manner or address, a result disagreeable to both parties would follow, only to be repeated day after day; and then we wonder why such ill feeling exists towards gas companies.

Certain rules and regulations may be necessary to the successful prosecution of the business of any large establishment. While system and order should be observed, officers or clerks whose position places them between the public and the company, particularly when that company happens to be a gas company, should be persons of good address, of well balanced minds, with ability to control their feelings, especially when the customer happens to be a person of the opposite nature.

We should always take as much pains to treat our customers with politeness as the retail tradesman takes to please his customers. The latter realizes that others in the same line of trade would take his customers' business, if he fails to satisfy them, and the nature of our business makes it all the more necessary for us to exert ourselves in this direction. Our customers are extremely sensitive to the fact that they are obliged to patronize us if they use gas, so that when a customer, from what he may consider ill treatment, leaves us in a disagreeable frame of mind, it instantly begets in him a desire for an opposition gas company, while he is entirely oblivious to the fact that another gas company would furnish the same kind of gas, sell it by meter measure, and transact its business in a similar way and expect to be paid for the gas supplied.

Such considerations lead us to the conclusion that gas companies should pursue a liberal policy towards their consumers. The old custom of charging the consumer for a portion of the service pipe and expenses of setting the meter, or of compelling him to be at the expense of employing a plumber to connect it, charging rent for the meter, charging for a little attention to pipes or burners—all these petty charges should be abolished. The revenue from these sources at the end of the year does not amount to a large sum of money, while the income from the increased sales of gas derived from new consumers, who may be induced to use gas when they know they can have a service run and meter set without charge, and no expense for meter rent afterwards, would in most cases be largely in excess of the former.

Our business is to sell gas, and the more we sell, the cheaper we can afford to sell it. The true policy of a gas company is, in the first place, to furnish its customers with a good quality of gas at a reasonable price, and offer liberal inducements for consumers to use it. To this end we should encourage the use of gas engines for power, regenerative burners where a strong light is required, and gas stoves for cooking and heating. Not a single family among our consumers should be without a gas stove for cooking; and they would not be if they knew the value, comfort, convenience and economy of it. Gas companies generally do not take such active interest in this matter as its importance merits. In some places individuals have kept gas stoves for sale, but the high prices which have heretofore ruled for good stoves, together with the little knowledge possessed by the people concerning their utility, has often resulted in small sales. The gas company has an additional interest in the general use of gas stoves over and beyond what any individual can have, because when the gas stove is introduced it secures a good consumer, and from the novelty, saving of labor in starting and caring for the fire, handling of coal and ashes, quickness of action, absence of trouble, comfort of cooking in warm weather and economy in cost, the consumer is both benefited and pleased. Occasionally we find a manager who thinks it an unwise policy for his company to supply its consumers with gas stoves, unless he sells the stoves at a price which yields a profit; and that to lease the stoves at a moderate rental, set and connect them free of cost to the consumer, is a waste of money. Such a policy I regard as shortsighted. In this as in many other matters I think a liberal policy the wisest one. From the fact that we know that a good gas cooking stove can be furnished, set and connected at an average expense of $12 to $14 to the company, I think there is no room for doubt that a gas company can afford to lease such stoves to its consumers at a moderate rental. In some cases, for the purposes of introducing the stoves quickly, I am not prepared to say that it would not be good policy to even give away a few stoves, as from experience we may safely anticipate approximate results. For instance, some managers consider that 12,000 cubic feet of gas may be calculated as a fair average quantity of gas which will be consumed during the season in each stove which is capable of doing the entire work of an ordinary family; but suppose we endeavor to make a safe estimate and call it 8,000 cubic feet; then 1,000 stoves would consume 8,000,000 cubic feet in a year. It is fair to suppose that an order for 1,000 stoves at one time would secure a discount from the regular prices; but these 1,000 stoves could be set and connected at a cost not exceeding $13,000. Now it is very easy to calculate approximate results for any location, and I think it will be found that in most places stoves can be furnished at a moderate annual rental safely and profitably, and in some places they may be actually given away for a time to the profit of the company. Many consumers have little or no knowledge of the proper conditions under which gas should be used for lighting purposes. It is not uncommon to see open burners consuming ten to twelve feet per hour, and giving no more light than should be obtained from six or seven feet per hour. A little attention and instruction given in such cases would avoid much of the dissatisfaction which consumers often bring upon themselves through ignorance of the proper conditions for burning the gas so as to obtain the best results, and this information should be supplied by the gas company.

Whatever we can properly and reasonably do to increase our sales is well, but we should not stop there. We must impress our customers with a feeling of confidence in our motives, and to do this we should interest ourselves in knowing as far as possible that our consumers burn the gas properly and economically. It must not be satisfactory to us to have a consumer use a large quantity of gas, and at the same time know that it is being used in a wasteful and extravagant way by the use of bad burners which consume a large quantity of gas and at the same time give a light which half the quantity of gas would give him by the use of a good burner. I think any gas company having more than one or two thousand consumers can profitably employ for such work a man of good judgment, one who has the requisite knowledge concerning the proper use of gas to obtain the best results; also the use of regenerative burners in places where they can be used to advantage. A gas company that simply runs a service pipe, sets a meter and takes no further interest in the consumer does not do its whole duty.

Many of us can remember the time when gas companies made no special effort to increase the consumption of gas; but that day has passed and the gas manager of to-day, if he is to be fairly successful, must be active and progressive. He must not only supply a gas of good quality for general use, and pursue a liberal policy towards the public but seek by all fair and proper means to popularize the use of gas and increase its consumption. Some companies have done and are doing so, but the time was when cast iron rules and regulations hampered the management and curtailed the sales of gas to a great extent. Until within a few years, competition with illuminating gas was practically unknown, although the discovery and introduction of cheap petroleum oil lessened the natural increase in the consumption of gas. The high price of gas at that time as compared with the present low prices favored the introduction of oil, particularly in those districts in cities where gas was not supplied; but its use entailed inconvenience and such disagreeable odor that customers unless from circumstances actually obliged to economize, preferred to use gas. Later on the electric light appeared. What followed? The newspapers teemed with statements that led timid holders of gas stocks to dispose of a portion or all of their stock. Prices of gas stocks were depressed. The electric light was heralded as the coming light.

The electric light construction companies were active in their work and in the formation of companies, and the installation of electric light plants, large royalties were demanded. By at least one of the electric light construction companies circulars were actually sent out conveying the intelligence to gas companies that their gas pipes would no longer be required to convey gas to customers for lighting purposes, for the electric light would supply that necessity, and the gas pipes would be used for distributing gas to be used only for fuel purposes. After several years of competition, what are the facts? Millions of dollars have been invested in the electric light business. Hardly a city or town of any considerable size in the country that is not, to a greater or less extent, supplied with electric light. This speaks well for the business enterprise of the electric light people. Without a doubt, many of the companies are earning dividends; some of them are not, even when operated by the local gas company with, as is claimed, less expense than an independent company can do it. With an earnest activity by enterprising men, the business has been pushed to its utmost limit. Contracts have been made for a certain price and for a certain time so as to bind the customer to its use.

Instead of adopting uniform rates and pursuing a policy of treating all customers alike, prices have been offered to suit circumstances and induce the consumer of gas to abandon its use and take the electric light. Some have done so, but few would abandon their old and sure dependence entirely and trust wholly to the electric light. Many private or isolated plants have been established, but not to the entire exclusion of gas. While millions of dollars have been invested in the electric light business, and it has increased with wonderful rapidity, and has, as I said before, reached almost every city and large town in the country, what about the gas business? Has it, with a single stroke of the pen of the electric light man, been wiped complely out of existence? By no means. The gas business was never in a more prosperour and flourishing condition than it is to-day. Never in the history of the business was so much gas distributed as is being done this very year. Gas stocks have the confidence of the investors of money, and the character and business standing of the greater number of the holders of gas stock throughout the country place them among the stable and conservative class. I believe we can afford to be generous enough to give electric light the credit for at least a portion of the progress we have made during the last seven or eight years, and it has been greater than in almost any previous equal length of time.

We furnish a better quality of gas. By improved apparatus and machinery we produce it at less cost. By new and improved burners, especially the regenerative class, we utilize three to four times the quantity of light from a given quantity of gas.

The scientific members of our fraternity have been spurred to greater activity in the line of improvements and inventions, because of the possible competitor which the electric light might prove to be. But we would not endeavor to belittle the influence of the present or the future of that wonderful mystery in nature, electricity, or its development as an illuminating agent. As scientific men, thoroughly interested in all that pertains to progress in civilization and the welfare and comfort of humanity, we welcome the advent of any invention, or any new adaptation of old principles, to subserve new and useful purposes.

But electricity with all its subtlety can never crowd out that equally wonderful element of nature, gas. The manufacture of gas to be used for the production of light and heat will be never superceded by electricity. The use of gas will be enlarged and extended. Illuminating gas is now extensively used as fuel for domestic purposes, and a gas is demanded which can be economically used for general fuel, not only for domestic, but for all purposes where heat is required.

Much has been said and written advocating a combination of the electric light companies with the gas companies. This may be well for both interests in some places, but I have yet to know of any reasonable or satisfactory argument why, in all cases, it is going to be better for the gas companies. The gas business, as well as the electric light business, will maintain itself upon its own inherent merits. I firmly believe that the business of any gas company will be managed better and will be more prosperous when the manager devotes his whole time, attention and energy to it; and just in proportion as his mind is diverted from it, whether by the electric light or any other business, his gas interest must, in some degree, suffer from such neglect.

The manufacture and distribution of gas and electricity to be used for lighting purposes are entirely dissimilar. The man who has chosen the gas business for his life work has a field in which the exercise of the brightest intellect, both in the line of scientific investigation and the highest order of business management, can find ample scope, and when his whole mind is concentrated upon his work, success will be more likely to attend him. My observation leads me to believe that bad results have followed already, at least in some instances, where gas companies have taken upon themselves the management of electric light in addition to their own business.

It is said that a gas company can operate an electric light plant and produce electric light at less cost than an independent electric light company can do it. This may, in one sense, be true, but really, in another sense, it may be at the expense of the gas interest. A glance at the report of the Massachusetts Gas and Electric Light Commissioners reveals the fact that the balance of profit and loss in quite a number of the electric light companies' accounts is on the wrong side of the ledger, showing that the statements often made that the electric light business is always a paying business is open to examination. Nevertheless, electric light has uses for which it is better adapted than gas can be, and for such uses customers can afford and will pay for it a price that will be remunerative to the compony that supplies it. Let us not deceive ourselves with the idea that electric light will not have its share of the business of supplying artificial light, or that gas will be crowded out. The field is a broad one and electric light will share it with us; but, so far, the increased demand for light has become such that we do not, as a rule, notice the inroad that electricity has made when we compare our "send-out" with that of previous years.

I have said that a gas is demanded which can be used economically for general fuel purposes. It has often been shown on paper, but not in a practical way. Many attempts have been made, circulars and advertisements have appeared, which would lead us to think that success had been reached: that gas for fuel could be produced and supplied for all purposes where fuel is required, and at living prices for the manufacturers. The nominal price per thousand feet of fuel gas is not so much the question as the more practical one, can a fuel gas be produced which will do the same amount of work as coal at the same or less cost? I do not mean to say that efforts have not been made to demonstrate that fuel gas can be made and supplied for domestic and mechanical purposes; but the pioneers in this line have not been so successful as to be able to demonstrate that a fuel gas can be made, distributed and used for general fuel purposes at a price that the consumer can afford to pay for it, and at the same time earn a fair return on the investment which is necessary to be made to carry on the business. I do not regard the fuel gas problem as an impossibility, and experiments are now being made which are claimed to be more or less successful for certain purposes and under certain conditions; but the active gas manager has little time to give to the development of this problem. The theorist has not the opportunity to demonstrate his theories upon a practical scale. We must await the solution of the question, whether certain work can be accomplished by the use of fuel gas at a cost of the solid fuel to do the same work. It is not a little surprising to watch the progress of events and to notice the eagerness with which the visionary minds receive the most absurd statements, when coupled with some pretended new invention; and, again, to witness the persistance which many so-called inventors will work night and day, literally wasting time and money in endeavoring to accomplish some result, which, a little knowledge of well-known natural laws and principles would teach them to be impossible. I would not depreciate the efforts of the honest toiler in the field of Science and Mechanism. He may produce something which shall prove a practical benefit to mankind; but how often do we see the "enthusiast," in his haste to become rich, or to startle the world by some wonderful discovery, while his pet ideas are yet crude and undeveloped, though printed and circulated

in well written pamphlets which abound in extravagant claims that have not been practically demonstrated. A "company" is formed with millions of dollars capital, and no matter how wild the claims set forth, men are found who will invest their money in the scheme. Even if the venture proves unsuccessful, the next one that comes along, promising great profit, will find some waiting to repeat the experiment. Hopeful writers may endeavor to encourage us by giving expression to their feeling of confidence in this or that process by which experiments are even now being made; but we must await the practical demonstration of the actual fact as a commercial success.

I had not intended to trench upon the subjects assigned by the Council to the several writers of papers which will be presented to you at this meeting. The subject of fuel gas will be treated from a technical standpoint by two of our members who are amply qualified to do so, as you well know—Messrs. Walton Clark and John Young—the latter having had a large practical experience in supplying natural gas.

When our Association was formed the President had an opportunity to bring to the Association much information in matters of improvements and experience which would be new to many of the members. Now we have placed before us every week by our several enterprising and ably edited Gas Journals, all the current news pertaining to our business, ably written articles on technical subjects and other matter of an interesting character; and I am fully conscious that the address of your President will be the least instructive part of our proceedings and is likely to be but a repetition of what you are all familiar with. In the several papers which will be read at this meeting you will have subjects discussed which possess more than usual interest and importance. The conduct of the "Electric Light Business in Connection with the Gas Industry," by Mr. W. H. Pearson, is a subject which many gas companies have practically taken up; and the account of the results of their experience will be listened to with interest by all the members of the Association. "Water Gas," by Mr. F. H. Shelton, and "Advantages of Supplying a Mixture of Coal and Water Gas," by Mr. T. G. Lansden, both of whom have had much experience in that direction, will no doubt give us such facts as will aid many of the members in deciding as to the economy or policy of supplying water gas wholly, or a mixture of coal and water gas.

Not the least in importance, as being vitally connected with the manufacture of gas is "Gas Coals of the United States," which was to have been read by Mr. H. C. Adams, whose knowledge of this subject renders him amply competent to deal with it in a manner that will interest us all. I regret to say that, owing to ill-health the writer of this paper desires to postpone it until a future meeting. The "Care and Operation of Gasholders," by Mr. C. L. Rowland, whose experience as a practical designer and constructor of gasholders, thoroughly qualifies him to speak upon his subject with authority and confidence. "Leakage and Condensation," by Mr. E. C. Jones, who is an earnest and devoted student in his profession; and I am sure he will give you some points in connection with his subject that will be new to you. Mr. B. E. Chollar will give you his experience with the "Purification of Gas from Kansas Coals." The purification of gas, although one of the oldest of our subjects, is one which is always interesting to us, and is receiving the attention of some of the brightest minds abroad as well as at home. I am sure his paper will receive that earnest attention which its importance merits. "Gas Calorimetry" will be treated by Prof. E. G. Love, of New York. This is a subject of special interest at this time, and from the experience and reputation of the writer could be placed in no more able hands. These papers will furnish ample subjects for consideration and discussion during the time at our disposal at this session of the Association.

Other topics of hardly less importance might come in for a share of our attention and one of these is the incandescent gas burner, of which several kinds have been brought to our notice within a few years. Like many other new things they have been heralded as being sure to revolutionize the manner of lighting, and companies for the manufacture and sale of them have been formed with millions of dollars capital, and yet comparatively few of them are in use to-day. There is no doubt that, in some degree, they possess merit peculiar to themselves, give a soft, mellow and very steady light and consume comparatively a small quantity of gas; yet, as a rule, they lack one or two fundamental features which every burner must possess if it is to be extensively used; and the first is they lack the elements necessary for the proper and thorough diffusion of light. It is not enough that a burner consumes a small quantity of gas if it does not possess the power to illuminate a space outside of a small circle immediately around the burner itself. Then, some of them must be used with a chimney, which adds trouble and expense; and last, but not least, the first cost of some of them will prevent their universal adoption.

The power of the diffusion of light is another subject which should receive more attention from the young scientific members of our Association than it has heretofore. As I have often remarked none of us can foretell the possibilities for development in our field of investigation, for it is practically illimitable; and how few of us endeavor to reach out and forward into the unknown. Many of us older members have crowded upon us the duties and cares of business management which monopolize our time to an extent which leaves little for continued application of thought, experiment and work outside of our daily routine of business. But we are already beginning to see a change for the better. Many of the younger members of this Association have been qualified by a thorough technical education to pursue investigation outside of our old and well beaten tracks. The most successful work will be accomplished, not by one whose knowledge is acquired from books only, but by him who is able, with experience in practical work, to bring to his aid the principles and theoretical knowledge which the books and technical schools furnish. This fact has in several instances been brought prominently to my notice by men whose scientific attainments were of the first order, and who could place upon paper the most promising theories, but from lack of practical ability and judgment were seldom able to work them out in practice, and unprofitable results naturally followed.

After practical experience and thorough techical education and training, our several Gas Associations and weekly Gas Journals place within our reach means for obtaining information and practical knowledge which we cannot afford to ignore. Some of our technical schools are now looking with favor upon the question of establishing a chair of gas engineering. The future usefulness of this American Gas Light Association never looked more encouraging and prosperous than it does now, yet the work accomplished will depend upon the united efforts of all the members. The revision of our Constitution has in several important particulars resulted in beneficial changes and added conditions which will tend towards the stability and permanency of our organization. Our membership comprises men who are known at home and abroad as successful managers, scientific investigators, men with years of experience in all the various departments of the business, representative men from all parts of the country, and young men with special education just entering into practical work, and by experience fitting themselves to take the places made vacant by those who by old age or death drop out of the ranks. The condition and prospects of the business of manufacture and supply of gas to be used for light, heat and power were never better than they are to-day.

The same energy, scientific and business ability which has been exercised by our electric light friends during the last seven or eight years, if concentrated upon invention and improvement in our own business, will show even more marked results than the most sanguine of our members now consider possible. We have the men, material and opportunity; and I dislike to say it, but we need something like the apparent competition of the electric light to spur us into activity in this matter. Until the last few years the conditions of our business were such that we allowed ourselves to drift into carelessness in management, into deep ruts of routine work, and slothfulness from which it will take time to recover.

The most successful managers through the next decade will be those who first read and comprehend the signs of the times, and at once adopt a progressive policy that will lead them to take advantage of acknowledged improvements where possible, and be able to furnish a good quality of gas at a price as low as can be done by any one under the same conditions and in the same locality. I would not be understood as advocating any wild or extravagant policy, but rather the exercise of calm and deliberate judgment, which, coupled with quick perception and comprehensive views of things, distinguish the successful man of the present day from him who, although having an existence in this year of our Lord, 1889, has views of business management which were outgrown and became obsolete twenty or thirty years ago. Competition in any business which has the world for its field means active and energetic work on the part of its promoters and increased sales and cheaper prices. Competition of one gas company with another on a limited field always has and must inevitably result disastrously for both companies and the public, because all the capital which is necessary to invest in works to supply that district with gas is already invested. When the capital is duplicated by an opposition company, then interest must be paid on two capitals out of the same business which the one company originally had, consequently both companies get tired of doing business with little or no profit, and they are compelled to district the territory or combine their interests; and in either case the price of gas cannot be reduced, but must be advanced to pay dividends on both capitals, or the stockholders must be

satisfied with a smaller return on their investment. Competition between gas companies and electric light companies in the supplying of light, heat and power partakes more of the nature of legitimate competition in trade; and yet it does not seem to be so much competition after all, for the electric light seems to have created a field for itself, inasmuch as we know that while electric light is used to a very great extent, yet the quantity of gas called for in growing cities does not grow less, but actually increases year after year.

We may be brought to the test of that imperious law, "the survival of the fittest," to decide whether our business can live and hold its own. I believe it can and will, and outside of the individual work of the members, this American Gas Light Association will be the source from whence shall emanate information and knowledge which will be of material assistance in maintaining our position of furnishing artificial light. The district Associations will aid by performing a share of this work. I am not of that number who have fears that the influence of the work and action of the district Associations will interfere in any detrimental way with the work of this Association. In a paper entitled "Gas Associations and Their Mutual Relations," read by our worthy Secretary last May before the Society of Gas Lighting, of New York, he considers this subject somewhat at length and from a standpoint of more intimate knowledge of the real effects of the influence exerted by the different Associations upon each other, and while he therein gives his reason why a certain detrimental influence is at work between the several Associations, yet he expresses my own views when he says: "That there is room for all these Associations there can be no question; for each performs work which the other organizations could not do and fills requirements which would be unfilled did not each Association exist." He then asks for "more systematic and more united action on the part of all the Gas Associations," and suggests that a committee for special work be appointed from this Association to work in conjunction with a similar committee from each of the other Associations. While I am aware that this subject is brought more prominently to his attention by reason of his position and duties as Secretary of this Association than it naturally would be to myself or the other members, yet I feel confident that the work and influence of the smaller Associations will never seriously interfere with the usefulness of this Association.

In the first place, our membership is largely composed of the more active members of all the other Associations. It does not seem to me that "every year increases the difficulty of obtaining papers, or that the standard of the dissertations is kept up better in the small Associations than in the larger ones:" and while, in his endeavors to secure writers of papers for this Association he has been answered, "No, I cannot write anything for the American Association, because I have to prepare a paper for some other Association, and I feel my first duty to be to my home organization," yet we have no scarcity of valuable papers here at our meetings. The reason, I think, why he feels as he does about this matter is because the principal work of securing papers has fallen upon him, but his efforts have been successful and we have the papers.

I feel that each Association has a field of usefulness for itself, and that each, if composed of active working members, will do its own work independently of the others; and if it is composed of members who do not or will not each do his share of the work, the sooner such an organization drops out of existence the better, and those members who are alive to their work and duty will ally themselves with this or some other Association which will be of some benefit to them and the companies they represent. While we recognize the influence and usefulness of each and all of the district Associations, from its numerical strength of membership, and from its comprehensive character, the American Gas Light Association must be the representative Association of this country; and it is our duty as well as our privilege to take the initiative in any work which is national in its nature and character, and this brings to my mind the suggestion, which I think was first made by President Ramsdell, of the Western Association, in May last, and that is to devise ways and means to have our great industry adequately and fittingly represented at the coming Quadri-Centennial, in 1892. As President Ramsdell remarked, it will be just one hundred years since Murdoch first made a practical use of illuminating gas by lighting his house and premises at Redruth, Cornwall. It will be a most opportune time to have represented the progress of our business during the past century. This will compare favorably with any of the great manufacturing industries of our time, and an opportunity is offered to commemorate the event in a manner that shall be worthy of the occasion, an opportunity which may never come to us again. As the subject is an important one, I recommend that a special committee be appointed to give the matter proper consideration and report to the Association some plan which, through well directed efforts, may result in something which will be a credit to the memory of past engineers and constructors as well as to those now actively engaged in invention and construction.

In an Association like this, now comprising a membership of more than 350, in the natural course of events, upon assembling together after twelve months have passed, we miss some familiar face and form and that kindly greeting which years of acquaintance at our meetings has made almost sacred. It is sad to know that death has been active in our membership during the past year. Mr. Robert P. Spice, of London, who was elected an honorary member of this Association, at the meeting in Cincinnati, in 1885, died on the 11th day May last. Mr. Spice was a man of more than ordinary ability and reputation. He was honored in America as well as at home. He served the British Association of Gas Managers as President in 1876–7, and was also a member of several other associations of a kindred nature. All who had the good fortune to become acquainted with Mr. Spice will miss his genial presence at our meetings, and will join his English friends in paying the respect due to the memory of one of our most esteemed associates. Of our active members, three have died during the year, viz.: John McDougall, President of the Hornellsville Gas Light Company, Hornellsville, N. Y.; C. H. Nash, President of the Gas Company at St. Joseph, Mo., and John Cartwright, of Poughkeepsie, N.Y. They have been identified with the gas business many years and we shall miss their presence at our annual gatherings. You will commit to kind friends, members of the Association, the duty of preparing a fitting tribute of respect to their memory to be placed upon our records.

Gentlemen, I have taken more of your time than I intended. We have much work before us, and trusting to your kind consideration in the further discharge of my duties, I hope that when the final hour of adjourment comes we may each and all feel impressed that this Seventeenth Annual Meeting has been, as it should be, profitable to us individually, and especially so to the several companies that we represent.

On motion of Mr. White, the President's address was referred to the following committee, for action, with directions to report back to the Association.

A. C. Humphreys, J. P. Harbison and J. L. Hallett.

BRIN'S OXYGEN PROCESS OF PURIFICATION.

The President:—We have with us to-day Mr. E. B. Ellice-Clark, of London. Mr. Ellice-Clark is a member of the Institute of Civil Engineers, and President of the Society of Mechanical Engineers. With your permision I will invite him to the platform, and ask him for a few remarks on the Brin oxygen process for purifying gas. (Applause.)

Mr. Ellice. Clark—Mr. President and Gentlemen: I came over to your great country for purposes of recreation, mainly, and I came to this city with a view of seeing and enjoying it for the first time; but when I heard that there was to be a meeting of the Gas Engineers and Managers of America, I knew that I could not more thoroughly enjoy, or more profitably expend my time in Baltimore than by attending this meeting. Certainly I shall go back to the old country very much impressed by the common sense address which I have heard delivered by your President this morning. (Applause.) It has more than ever convinced me of the thorough, sound and common sense view that the Americans take of such practical questions as the manufacture of gas. I hope that the few remarks which I am to about make will be following out one of the principles which your President has laid down. He has said, and said very truly, not only for your country, but certainly for mine, that the gas industry can no longer be left in the hands of incompetent men; that science must be brought to bear in prosecuting this great industry. Now, in England, and no doubt in America, science has for a number of years been practised in the question of the purification of gas, and I happen, as a civil engineer, to be associated with a process to assist in the purification of coal gas, which has met with a large measure of success in the old country, and that is the process of introducing free oxygen into the gas and continuing the purification by means of lime. I do not know whether the method of obtaining pure oxygen from the atmosphere by the Barium method is well understood in this country, but certainly it is a most practicable process, and, in my judgment, and in that of a number of the scientific men of England, it is one of the most remarkable applications of science ever made; because in the works that we now have in England and one on the Continent, the results tend to show, as it were, a manufactured article passing out of the factory, being sold, and nothing coming in, as the raw material is the oxygen of the atmosphere. I will in a few words attempt to describe the method of separation. It is almost a mechanical process. It is hardly a chemical process, as there is no permanent change in the BaO. The atmosphere is drawn through

a purifier of lime to take out the carbonic acid. It is then drawn through caustic soda to eliminate the moisture, leaving only 21 per cent. of oxygen and 79 per cent. of nitrogen passing to a furnace. This air is then drawn through, or rather pushed through a series of steel retorts, hung vertically in a furnace. The retorts are 7 inches in diameter, and may be from 6 to 18 feet in length. They are heated up to about 1400° F., so that there is a series of retorts suspended vertically in a furnace fed by producer gas. These retorts are filled with oxide of barium, obtained from the refuse of lead mines. The baryta is first converted into the nitrate, then into oxide; then broken up into pieces about the size of a walnut and placed in the vertical retorts. The air is drawn through the purifiers, which I have already described, and passes through the retorts. The outlet valve is weighted to 15 pounds above atmospheric pressure. When the oxide of barium is heated to a light cherry red it seizes hold, so to speak, of the oxygen in the atmosphere, and it rejects the nitrogen. Therefore, the nitrogen escapes at the lower end or bottom of the retort into the atmosphere, as free nitrogen, the oxygen remaining in combination with the barium in the retorts. For five minutes pumping-in takes place; then by an automatic arrangement, the outlet valve for nitrogen closes itself. The pumps are reversed in their action, and the oxygen is forced to a gasholder. This operation goes on six times every hour for twenty-four hours a day, every day in the week, and it has been repeated upon the same barium now for two years in succession without any deterioration. On the contrary the oxide of barium slightly improves in its capacity for yielding up oxygen. That is to say, we obtain a little more oxygen now from the operation than we did seven or eight months ago. So that the process is a continuous one, and it is an exceedingly cheap one. In fact, in the coal districts of England, oxygen of 90 per cent. purity may be made in a gas works as cheap as coal gas. Now, I come to what no doubt is much more interesting to you, that is the application of oxygen to the purification of coal gas. Not being a gas engineer, no doubt you will soon find this out when I begin to talk about the purification of gas; but any discrepancies I am sure you will excuse. If you will refer to Mr. Valon, of Ramsgate (who has been now working on this process for two years consecutively) where there are obscure points or for explanations of the process, which I do not make quite clear, he will be glad to enlighten you. The oxygen is passed at about from three-quarters to one per cent. by volumn into the crude gas at its entrance to the purifiers. The first experiments were made at Blackburn, by Mr. Ogden, with a special plant. He treated continuously four million cubic feet of gas. The effect of that was that, whereas Mr. Ogden would have had to change one of his purifiers every twenty-four hours, he ran for sixty-eight days consecutively; and in my presence he said that the purifier would have gone on for eighteen months at least. At Manchester, I understand, the oxide is taken out of the purifiers for the purpose of reoxidation by the atmosphere, and there is such a large quantity of it that they use a horse and plow to turn it over. Therefore, if it is possible, by the introduction of cheap oxygen into coal gas, to practically insure the purification of that gas in closed vessels, a great step has been made in purification. When Mr. Valon was making his experiments he began to make some observations with oxygen and lime. He used to purify the whole of his gas with oxide; but determined to throw out the whole of the oxide and to go back to lime purification. Ramsgate is a health resort, and he had abandoned lime purification because the gas works are situated in the center of the town, and the smell of spent lime was very obnoxious, and caused a great deal of annoyance when it was removed. Mr. Valon found that not only was the purification effected much more rapidly by using oxygen, but that he only required half of the purifying space. The crude gas at Ramsgate contains 800 grains of sulphur per 100 feet of gas. This was reduced to eight grains. The carbonic acid, I think, amounts to 650 grains, and this is entirely obliterated. But what is more surprising is the increase of luminosity. The coals used at Ramsgate gave 10,000 cubic feet of gas per ton with a luminousity of 15½ candles. For the purpose of revivifying the gas about three-fourths of one per cent. of atmospheric air was used, and the effect of this was to reduce the luminosity by 2½ candles. This luminosity was brought up by the introduction of 2½ to 3 per cent. of cannel coal. When oxygen was introduced Mr. Valon obtained from 3 to 3½ candles of increased luminosity. He thereupon abandoned the use of cannel coal and brought up the gas that he was manufacturing to the normal standard, and more than that, to an additional one-half candles without the use of cannel. So that by introducing oxygen into his gas, Mr. Valon has been able to abandon the use of cannel. He has reduced his sulphur compounds to 8 grains, and he is now carrying on a series of experiments whereby he has thus far ascertained that he can make, instead of 10,000 cubic feet of gas per ton of coals he will probably get from 11,000 to 11,500, and still serve his customers with gas of the same luminosity and of increased purity.

I am not going to detain you with any more remarks on this subject. I have given you the result of the experiments that have been made by Mr. Valon, extending over a period of two years. In coming to your country for the first time, and landing in New York (and even in this city of Baltimore) one cannot but be struck by the enormous advances which electric lighting appears to have made in the United States, and I was exceedingly glad to hear from your President that the gas industry had not suffered thereby. Well, you may look at it from that point of view; but as a stranger, I cannot but think that if gas in this country had been all that it ought to have been, then the electric light would not have made such strides. That is the impression upon my mind. Certainly in England the electric light has made no such strides as it appears to have made in this country; and fuel being just as cheap with us there is no reason why it should not. I may be wrong, but my own opinion is that the reason why the gas industry in England has held its own, and will continue to hold its own against the electric light, is by reason of its economical production and the great care that English and Scotch engineers devote to their business. First of all, we do, by Parliament and by Statute, what competition will, I think, compel you to do in this country. As most of you are aware, the gas companies in England are compelled to keep their sulphur compounds down to the lowest known practicable limit. They are obliged to give gas of a certain candle power; and in London at a certain price. Therefore, being compelled to do this, they not only do it; but, do a great deal more. For, whereas the Statute says that they shall give gas of 16 candles, very often the mean luminosity is 17 or 18 candles. The fact is that the gas engineers, by these statutes, have been put upon their mettle; and now they make and deliver gas cheaper, and of better quality, and of higher luminosity than is required by any statutory regulations. Therefore, the electric light engineers have a much stronger competitor to deal with there than they have here. My impressions may be wrong, but I cannot but feel that if all the gas companies in this great country were working on the same line—delivering to their customers gas at a low price, gas of a standard luminosity, and of a standard quality of purity, and if they had adopted the best known practicable means for attaining this, you would not have so much to fear from the electric light and as corecion is always to be avoided if possible even in regulating a monopoly one is very glad to form the impression that you will do by open competition that which in England has been forced upon gas engineers by an Act of Parliament. (Applause.)

In conclusion I am very much obliged to you for your kindness in allowing me to address you.

Mr. Jones—I would like to ask Mr. Ellice-Clark one question: In taking the air from those retorts, what vacuum do you use?

Mr. Ellice-Clark—A 27 inch vacuum.

Mr. Walton Clark—Mr. Ellice-Clark has disclaimed any knowledge of gas matters, and, therefore, it will not be discourteous in me to correct some errors into which I think he has fallen. We know that in England they are confined by Statute to a certain quality and illuminating power of gas. We know that they are allowed a certain number, generally 20 grains of sulphur per 100 cubic feet of gas, and that they are not allowed to go below 16 candles in illuminating power. But we also know that in this country, without any such regulations, it is rare that you find gas containing more than 12 grains of sulphur per 100, or gas under 18 candle power. (Applause.) The electric competition may not have hurt English gas men as Mr. Ellice-Clark assumes that it has hurt American gas men; but, if so, it is not on account of the quality of the gas; nor is it on account of the price of gas. In England it is true that the gas is made cheaper because of the cheaper labor, cheaper coal, and cheaper materials generally; but those influences affect also the cost of electric lighting.

I would like to ask Mr. Ellice-Clark a few questions as to the Brin process. I have read with a great deal of interest Mr. Valon's recent utterances on this subject, as also the comments which have appeared in some of the American Journals. Mr. Clark has not stated, nor has Mr. Valon, whether the absorption of the oxygen is due to the formation of a double oxide, or whether the oxygen is included in the barium. This is matter, perhaps, of no great practical interest, but it is of considerable scientific interest. Mr. Valon has said in writing that air will do as well as oxygen, independent of the effect upon the illuminating power of the gas. I would like to ask Mr. Ellice-Clark if he will explain why this is. Mr. Valon did not attempt to explain it, but it may be that his more recent experience has enabled him to do so. It cannot be because of the greater dilution of the gas. If we have 1 per cent. of pure gas we have a dilution of 100 to 1; and if we have 5 per cent. of air, we have a dilution of 95 to 1, and the difference is not great. Mr.

Clark has stated also that three-quarters of 1 per cent. of air mixed with Mr. Valon's gas reduces the illuminating power 2½ candles. I believe that that is in excess of what has been found in this country. We have been led to suppose that we could introduce considerable more air than that without reducing the candle power materially. On the gas that they are supplying that reduction would be from 12 to 14 per cent. of the illuminating power, and if my memory does not fail me, we consider that 1 per cent. of air will reduce not more than 5 per cent. However, I am not certain on that point, but I know that it is very much less than Mr. Ellice-Clark states.

Mr. Ellice-Clark—I do not think that the chemical reaction of the conversion of BaO to BaO_3 and the reconversion of BaO_2 to BaO is very well understood. The BaO takes up another atom of oxygen when it is exposed to a temperature of 1400° Fahr. under pressure, and it yields it up under a vacuum; and that will go on indefinitely for 20,000 or 100,000 times.

Mr. Walton Clark—Does the temperature remain the same?

Mr. Ellice-Clark—Yes; the temperature is constant.

Mr. Walton Clark—Then it would seem to me that the oxygen was included in the material.

Mr. Ellice-Clark—When first we commenced the operation of making oxygen we used a temperature of 600° C. when forcing in the air, and obtained a yield under vacuum at 800° C. But, after extended observations and experiments by engineers and chemists, we found that we could obtain the oxygen at a constant temperature. I did not mean to say that by the introduction of oxygen in the gas Mr. Valon was able to get 11,000 feet of gas where he only got 10,000 feet from his coals. What I meant to say was that Mr. Valon used to get 10,000 feet of gas from his coals, giving a certain luminosity; but he is now experimentally pushing the distillation of coals further and is getting from 11,000 to 11,500 cubic feet. Of course it is of an inferior quality, but the introduction of oxygen in the purification brings up the luminosity. This increased illuminating power has been attributed by those who have investigated the subject to the higher temperature of the flame by reason of a small quantity of oxygen passing through the purifiers and raising the temperature of the flame at the point of combustion.

Mr. Pearson—I have heard it said that cheaper gas would kill the electric light; but fuller investigation satisfied me that in England it was not the cheap gas that kept out the electric light, but that it was legislation. An electric light company there would have to give up its charter at the end of about ten years. After the company had got itself into good working order and begun to make money, then it would have to give up its charter to the government. Perhaps Mr. Ellice-Clark is not aware that to-day in the city of London the Westinghouse people have introduced one of the largest electric light plants in the world, and expect in a very short time to have it in operation. Moreover, in most of the large hotels in London they are using the electric light because they claim that the gas is so full of sulphur and other impurities that it blackens their decorations. I simply make these statements because I am credibly informed that such is the case; and I have recently heard from a rising gas engineer of very considerable note that incandescent electric lighting is making very considerable headway in the city of London. There was another thing which struck me while Mr. Ellice-Clark was speaking, and that was when he was speaking of the process by which he obtained the oxygen. The question occurred to me—how much does it cost? Bringing it down to dollars and cents, what is the gain obtained per thousand feet of gas, as compared with the present process?

Mr. Ellice-Clark—The gain is $31 per million feet. The gentleman's arguments are really arguments in favor of using oxygen with gas. He says that he was informed (therefore, he has his information second hand), that the reason why gas was being ousted by the electric light was because of the considerable amount of sulphur contained in the gas. I think that that is perfectly true; and Mr. Valon's investigations has enabled him to reduce the sulphur compounds from 20 grains per 100 feet, to a constant of 8 grains. If the hotels to which the gentleman alludes, had been supplied with gas containing only eight grains of sulpher per 100 feet they never would have had electric light. (Applause.)

Mr. Pearson—I do not wish to be understood as saying a word against Mr. Valon's process; but I am simply asking Mr. Ellice-Clark as to what was in existence, and as to what caused it. I quite agree with Mr. Ellice-Clark that if there had been less sulphur the result would have been different. But that such is the case I have the most unquestioned authority for the statement that electric lights are not used in these hotels very largely on account of the presence of the impurities.

Mr. Nettleton—Mr. Clark stated that when Mr. Valon or some other gentleman was using oxide in his purifier that the purifying boxes lasted 68 consecutive days withithout changing, and that in the opinion of this gentleman it would have lasted 18 months. Then Mr. Clark said that Mr. Valon tried to use lime. But he did not say how long the boxes went without changing. I would like to inquire if the boxes of lime would last as indefinitely or for as great a length of time that the boxes of oxide last. If so, it seems to me to be a very important thing for this Association to take up.

Mr. Ellice-Clark—Mr. Valon states that the boxes with lime would last three times as long with oxygen as they would without oxygen. Not comparing it with the oxide at all, but taking lime without oxygen and lime with oxygen.

Mr. Littlehales—I wish to ask Mr. Ellice-Clark a couple of questions. The first is if he can give us an idea at what rate per thousand feet the oxygen was introduced; and the second is if the system is practicable in gas works of small or moderate size. With reference to what has been said about the difference in the price of gas in this country and in England, I think the most important element that enters into that question has been lost sight of on both sides, and that is the difference in the capital account. The construction account in this country is very much larger, for there is no such thing as stock watering allowed on the other side. Before a company is started there they are limited very strictly by Parliament as to the capital which shall be employed. A committee of the House of Commons investigates very carefully, and finds out how much capital is necessary for a company in any given locality; and that limits it. That is a very important element which enters into the consideration as affecting the price of gas.

Mr. Ellice-Clark—First, as to the cost of oxygen. In England it follows very nearly the cost of coal gas. It depends very largely upon the price of coals. You may take it that whatever it costs to make coal gas, oxygen will always cost about the same. The other question was whether this process is applicable in works of moderate size. Several gas companies or corporations have ordered plants and are putting them up. The smallest is at Shrewsbury, where they want 5,500 cubic feet of oxygen per day. But oxygen may be made economically with a plant for the production of 1,000 cubic feet in 24 hours. That is the smallest plant with which you could produce oxygen economically.

On motion of Mr. Harbison, a vote of thanks was tendered Mr. Ellice-Clark for his courtesy, and for the information given.

AN INVITATION AND TWO LETTERS.

Mr. White—We are requested by the local committee to invite Mr. Frank Morrison, the President of an Electric Light Association, to a seat in our body during the meetings of this Convention. If there is no objection, I move that Mr. Morrison be invited to meet with us at his pleasure. [Adopted.]

The Secretary—I have a letter here from the Mayor of Chicago, and also a like letter of invitation from the Committee on Gas Industries for the World's Exposition, of 1892, at Chicago.

The World's Exposition of 1892,
Committee's Headquarters, 183 Dearborn Street.
Executive Committee, Chicago Oct. 14th, 1889.

Dear Sir:

In behalf of the citizens of Chicago, I take pleasure in inviting your Association to hold its annual meeting in 1892 in this City. We would be pleased also to have the International Gas Meeting of 1892 held here at the same time, when we hope to have the World's Fair here.

Yours truly,
DeWitt C. Cregier, Mayor of Chicago.

To the President American Gas Light Association, Baltimore, Md.

The World's Exposition of 1892.
Committee's Headquarters, 183 Dearborn Street.
Chicago, Oct. 14th, 1889.

President of the American Gas Light Association, Baltimore, Md.

Dear Sir:—In behalf of the citizens of Chicago we hereby extend to your association an invitation to hold its annual meeting in 1892 in the City of Chicago. An invitation is also extended to the International Gas Association to hold their meeting in this City at the same time. Ample facilities will be provided for the occasion.

Yours respectfully,

Joseph S. Woodruff,
Charles D. Hauk,
H. D. Harper,
C. A. Vosburg,
F. W. Wilmarth,
H. W. Willard,
Committee on Gas Industries for the World's Exposition, 1892, at Chicago.

The Association here took a recess, until 2:30 P. M.

FIRST DAY—AFTERNOON SESSION.

The Association met at 2.30 P. M.

The President—The first paper this afternoon will be read by Mr. E. C. Jones, entitled

LEAKAGE AND CONDENSATION.

In no other industries are the energies of the manufacturer more devoted to the study of economy than in the manufacture of gas.

Within the gates of the modern gas works the superintendent is actively engaged in developing new methods of reducing the cost of production, by increased regeneration in the furnaces, lengthening the life of purifying material, and endeavoring to make the residual products pay for the coal carbonized, and each success in reducing the cost one-tenth of a cent a thousand feet is hailed with delight, while outside the gates a sum nearly equal to the value of all the fuel used in the works, and equal to four times the cost of purification and nearly equal to the retort house labor, is going to waste. Is not the subject of leakage of vital importance, and a rich field for the best efforts of the gas manager?

To demonstrate that it does not receive the careful supervision given to other departments of our business, I will quote from King's Treatise. "Let us take the production of gas and the leakage or loss throughout the United Kingdom as it was twenty or twenty-five years ago, and compare them with the production and unaccounted for gas at the present time, and we shall probably find an increase in the actual leakage over that of twenty-five years since, although the percentage of loss is considerably less."

The same unwelcome condition of things probably exist in the United States. The percentage of unaccounted for gas of 56 companies in Massachusetts for the year ending June 30, 1887, was 12.53 per cent., while for the year ending June 30, 1888, the average of 58 companies was 13.17 per cent.

A glance at the following table will convince the most skeptical that the percentage of unaccounted for gas of the companies of the State is increasing instead of diminishing:

	1887.	1888.
Towns with leakage under 5 per cent.	3	3
" " " between 5 and 10 " "	23	16
" " " " 10 " 15 " "	17	23
" " " " 15 " 20 " "	6	8
" " " " 20 " 25 " "	3	6
" " " " 25 " 30 " "	2	1
" " " over 30 " "	2	1

In an era of close competition and small profits it seems a pity that one of the greatest industries of our country is not able to account for a loss, in a single State, of 13.17 per cent. of its product, amounting to over 276 millions of cubic feet of gas, which at 11,000 feet per ton would require over 25,000 tons of coal for its production. In Massachusetts it is evident that the large and increasing leakage is due chiefly to small mains, and the severity of the climate. In looking over the length and sizes of the mains, it is noticeable that the percentage of unaccounted for gas is inversely as the size of the pipe, other things being equal. To bring the fact clearly before you I have calculated the internal area of the mains of each company (*i. e.*, the number of square feet of iron with which the gas comes in contact). The average main area of each company is 113,629 square feet, and the average area of each mile of pipe is 5,297 square feet. From this we find the average diameter of all mains in the State to be only $3\frac{8}{10}$ inches.

It is a circumstance worthy of consideration that the greater the main area per mile the less the leakage.

No. Companies.	Area per mile of main.	Leakage.
16	Under 4,500 square feet,	14.9 per cent.
8	Between 4,500 and 5,000 square feet,	13.7 "
8	" 5,000 " 5,500 " "	11.8 "
11	" 5,500 " 6,000 " "	10.4 "
10	Over 6,000 square feet,	10.0 "

Another way to demonstrate that small cast iron mains are one of the causes of large leakage would be to ask the members how many pair of clamps were used last winter to repair broken 6, 8, 10 and 12-inch mains, and how many were used for the same purpose on 3-inch mains. In fourteen years I have been called upon but twice to use 6-inch clamps, and I have never had occasion to use larger sizes, while broken 3-inch mains are of common occurrence.

The structure of cast iron is such that the small amount of metal in a pipe three inches in diameter, or less, will not withstand the underground forces of freezing and thawing. The larger pipes are subjected to the same strains, but possess strength to resist them, and do not break. If the unequal expansion and contraction of soils of different degrees of conductivity could be represented in pounds pressure, and the pipe considered as a beam for carrying the load, I think all mains of less than six inches diameter would be of wrought iron. I have entirely given up the use of 3-inch cast iron pipe, and in streets where there is a prospect of a considerable consumption of gas, a 6-inch main is laid.

Much has been said of exosmose, or the leakage of gas through the pores of the iron, and I think it is overestimated. One company has 6,022 square feet of area per mile, and a leakage of 11.5 cubic feet per square foot per year, while another company has 3,864 square feet of area, and a leakage of 60.6 cubic feet per square foot, showing that if there is any transpiration of gas through the pipe, the amount is very small. Large mains properly cared for, are a preventive of large leakage, and the cost of additional metal used in them, when considered as an insurance against breakage, is a profitable investment, aside from the advantages of large mains for supplying increased demands for gas for engines, heating and cooking.

A brief description of the system of laying mains, testing, and finding leaks, in use in South Boston, may be of interest.

All cast iron mains are laid with cement joints, made by using two hard twisted rolls of lathyarn and a mixture of two parts common cement, one part Portland cement, and one part sand. After the joints is made, it is carefully pointed at an angle of about 45°, with quick-setting cement. The joints when properly made are rigid, and fully as strong as any part of the pipe. At each street intersection a long end

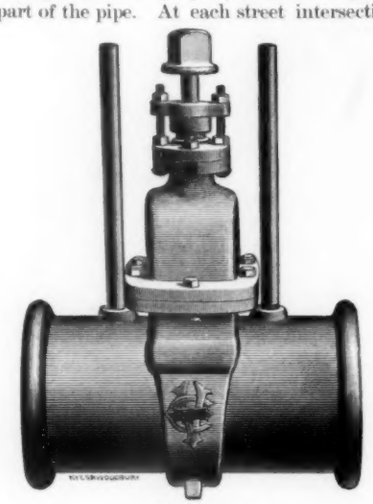

FIG. 1.

valve is put in, and on one side of the valve is a lead joint to allow of expansion and contraction in half of the block. The object in having the lead joints at one side of the section valve, is that they are exposed to view, and any leakage may be quickly discovered upon raising the cover of the valve box. My reason for not using lead joints generally is the belief that all lead joints leak, and it is preferable to have one broken main to having a thousand of small leaks which are not large enough to make their existence known, yet swell the amount of unaccounted for gas.

It has been pointed out to us, as long ago 1860*, that the difference between the contractile power of iron and lead is as 9 is to $3\frac{1}{2}$, therefore as an iron socket contracts nearly three times as much as the lead joint, the iron compresses the lead and crowds a portion of it out of the socket, and upon the return of warm weather, when the socket expands, the lead does not expand enough to fill it, and a gas-way is left between the iron and the lead. An ordinary engineer's book made of cross section paper, is used to record in the simplest manner the location of each valve, special casting, and lead joint.

In connecting a service pipe with the main, instead of a bend or elbow we use two street elbows. The first is screwd into the main, looking in the same direction the main is laid, and into this the other is screwed, looking at right angles to the main. Two street elbows screwed together in this manner, form nearly a universal joint, making it possible to run the service at any pitch without strain, and allowing for movement of main or service in any direction, without risk of breaking.

Regular and systematic tests of the mains are made by means of a ten-light meter, fitted with a rate dial on the top, and furnished with

*Report of T. Spencer, *Journal of Gas Lighting*, Sept., 1860.

pipes by which it may be connected with the three-qurater inch pipes on each side of the street valves. The meter is protected against frost or careless handling by being enclosed in a tin box, and the space between the meter and the box is filled with dry sawdust. The tin box is provided with handles by means of which it may be lifted in or out

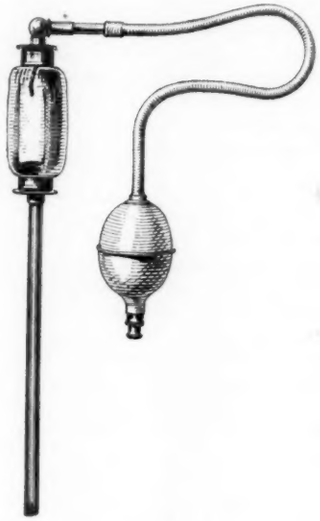

FIG. 2.

of a wagon. With mains divided into small sections, and a thorough knowledge of each section and the probability of day consumption in each, we are enabled to locate leaks with the greatest nicety.

In districts were gas engines are in use, or where there is known to be a large day consumption, it is necessary to resort to Sunday testing, and it is sometimes desirable to send cards to consumers on a section of main where the meter indicates a leak, or that gas is being used, notifying them that the gas will be shut off for ten minutes for the purpose of testing. When a leak is discovered of sufficient size to warrant further search, we make use of a twisted steel sounding bar, fitted with a loose cross-bar handle. This bar is driven into the ground by means of a sledge, at short intervals, turning as it is driven, until it is near the main, when, on account of its spiral shape, it is easily removed, even from the most closely packed or frozen soil. If it is preferred, a hexagonal steel bar similarly fitted with a wrench handle may be used, and is easily withdrawn. By the well known means of smelling, carefully judging the quantity of gas at each bar hole, and digging where the odor of gas is strongest, the leak is found. Of late I have tested for leaks with some success by means of an aqueous solution of palladium and gold chlorides, prepared from the formula given in a paper by Emil Merz, of Carlsruthe.

The sense of smell is fallible and unreliable, and a solution sensitive to gas, with which test papers may be made for locating leaks with the utmost certainty, is a useful companion in the search for leaks. The solution giving the best results is composed of 3.75 grammes palladium chloride, and 1.25 grammes gold chloride dissolved in 1 liter of distilled water. In Germany where this method of finding leaks has been practiced, it has been the custom to moisten a slip of filter paper with the solution and insert it in a glass tube, fastened to the end of a piece of iron pipe. After driving a bar, and making a test hole, this piece of pipe is lowered into the hole, and if gas is present, it rises through the pipe, and discolors the test paper. This test occupies fully fifteen minutes, and to save time and increase the efficiency of the test, I have devised a simple piece of apparatus.

A piece of quarter-inch pipe, four feet long, is fitted at one end with a glass bulb six inches long and 1½ inch diameter. This bulb has a removable cap, on the inside of which is a wire hook for holding a slip of test paper. A short piece of rubber tubing connects the cap with a rubber aspirator bulb.

To use this device, the test hole is first made by driving a bar. A slip of paper is moistened with the test solution, and suspended from the hook within the class bulb. The quarter inch pipe is then lowered into the test hole, and by squeezing the rubber bulb the air is exhausted from the apparatus, and if there is gas present in any part of the test hole it is drawn up into the glass bulb, brought in contact with the test paper, producing a reaction, and is expelled through the rubber bulb,

The reaction with this useful reagent commences by the test paper turning a light rose tint, which is followed by a series of drab and

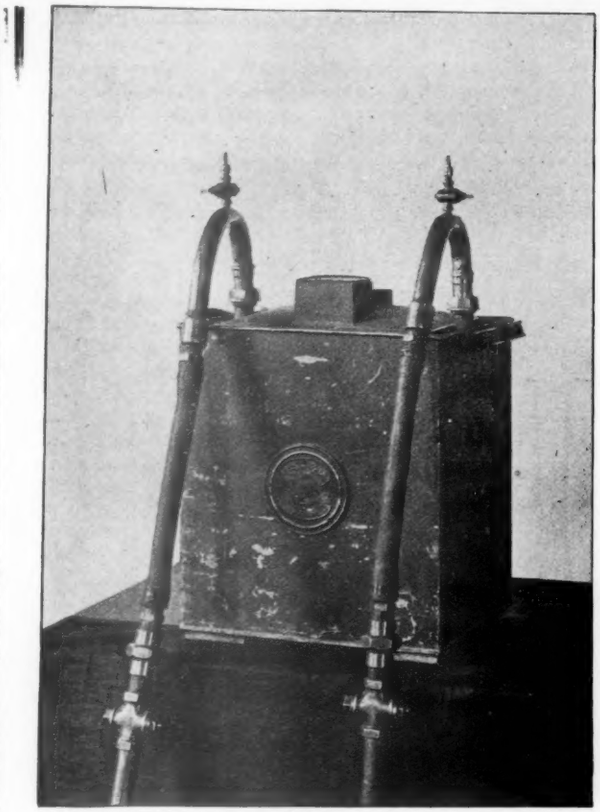

FIG. 3.

brown shades, until it becomes a dark seal brown. The reagent is not extremely sensitive, although it requires some care in handling, and the variety of shades of color accompanying a complete reaction enables the operator to nicely judge the extent and proximity of a leak.

One is well repaid for using this simple test, both by the interest excited by the beautiful reactions, and the fact that unlike the olfactory nerves, it tells a truthful story, and is never tired.

A large portion of unaccounted for gas is directly attributable to the difference in volume of the gas at the temperature at which it is measured at the station meter, and the temperature at which it is sold at the consumers' meters. It is customary at the larger works to record the temperature of the gas at the station meter at frequent intervals, and at the South Boston works the temperature is taken hourly, and carefully recorded. The measuring temperature of the gas at the largest works in Massachusetts, last year, was 61°, and at South Boston the average measuring temperature was 67.7° F. The question at once arises, the measuring temperature being known, how can we establish a selling temperature?

In my calculations of condensation or shrinkage I have used, as a constant for corrections, a figure nearly representing the mean earth temperature at the depth of three feet, for in moving through the ramifications of underground pipes, the gas will assume the earth temperature at the average depth of the pipes.

To assist me in the study of earth temperature I have had recourse to the reports of the Underground Temperature Committee of the British Association, and I find that in the temperate zones the mean annual earth temperature, at a depth of three feet, does not vary appreciably from the mean air temperature in the same locality. So that the mean air temperature for a year in a given place furnishes a constant with which to correct the volume of gas made, or, in other words, a selling temperature.

Mr. Symons, at the Botanical Gardens, London, found the joint mean of earth temperature taken at depths of 3, 6, 12, 24, and 48 inches, for six years from 1871 to 1876, to be 50.5° F., and the mean air temperature taken at the same time and place 49.6° F. Observations by Quetlet, at Brussels, for three years, make depths less than 1½ feet colder, and at greater depths warmer than the air.

The greatest excess of earth temperature over air temperature is to be found in a series of observation taken in Scotland, where the surface

and subsoil was sandy and dry. The air temperature was 46.1°, and the earth temperature at the depth of 22 inches was 48°.

The mean air temperature of Boston for 18 years from 1871 to 1888, was 48.1° F., and I find this does not differ much from the earth temperature at a depth of three feet. The mean earth temperature for five months from January to May, 1889, being 49.1° Fah.

With the temperature of the gas at the station meter and 48.1° Fah., as a constant selling temperature, I am enabled to find how much of the gas not used by street lights and registered by consumers' meters is actual leakage. For the year 1888 the difference in volume of South Boston gas, thus calculated, was 3.8 per cent., and of the portion of Boston gas manufactured at the North End station, 2 1-2 per cent. condensation due to difference in temperature.

Discussion.

The President—I think you will all agree we me that this is a very interesting paper and one worthy the fullest discussion. The conditions of condensation and leakage are so variable in different parts of the country that I am sure you will be able to get considerable information from the paper. It is now open for discussion.

Mr. Snow—I would like to ask Mr. Jones if he ever finds his service pipes stopped because of the presence of naphthaline; or if he has found the joints started by rust or dirt settling in the extra joint.

Mr. Jones—I have taken out connections of this kind, within a week, which had been in for seven or eight years, and I have not found any of them stopped, even with naphthaline. I have had occasion to lay about 3,500 feet of new ten-inch pipe, and most of the service pipes on the three-inch pipe displaced were *fitted with two street elbows.* I found them in excellent condition, and none of them started.

Mr. Lamson—I would like to ask Mr. Jones if, in using this new form of test for leakage, he has been able in his experience to find any leak which was difficult to be determined by smelling? How much experience has he had in using that test?

Mr. Jones—I have not had very much Winter experience with it, but I have used it every time that I have had occasion to look for a leak within the last six months. My attention was called to it by Mr. Nute, of Jersey City, and I took hold of it and found that, by the use of this apparatus, I was able to draw the gas from a place very near the main up into the bulb and bring it in contact with the test paper, so that if gas is present in any part of the hole I am sure of bringing it in contact with the test paper and thus find out its presence. A few squeezes of the ball exhausts this gas bulb, and the gas or air follows up the pipe and comes in contact with the test paper.

Mr. Lansden—I would like to ask Mr. Jones what his opinion is with regard to condensation. What proportion of loss does he figure as due to condensation?

Mr. Jones—I will say that I am afraid that the subject of my paper, "Leakage and Condensation," may have led members to think that I was going to treat an entirely different subject. Perhaps I ought not to have used the word "Condensation." As it occurs in my paper it refers simply to shrinkage from difference in temperature. I have not enough considered the subject of condensation due to the deposit of the hydrocarbons in the gas to be able to give any information.

Mr. Lansden—Is it your opinion that most of the loss is due to leakage instead of to condensation?

Mr. Jones—My paper says that in South Boston we have a difference of about three per cent. due to shrinkage from difference in temperature.

Mr. Taber—I have made a few figures with regard to the temperature of gas. I live in very nearly the same latitude as Mr. Jones, but I differ with him in finding that the temperature of the air is about 47°, while that of the earth, I find, is a little bit lower than his statement—57°; and yet I find that the amount of condensation due to the state of the temperature is estimated very closely to his—about three per cent. I was not aware that he was working on those same lines, and I am glad to find that we agree so closely. I think that the three per cent. of loss is not a loss actually, but simply a difference in the measurement affected by temperature.

Mr. Gilbert—After some 30 years in the management of small works I have come to the conclusion that our loss of gas is mainly attributable to two faults. One is, not laying pipes deep enough in our colder latitude; and the other is the careless and imperfect work in the making of joints. In the early days of the gas industry, and up to within 20 years, our superintendents and the men who have charge of that part of the business have largely come from Scotland; and there they generally find it necessary to lay their pipes as deep as we do. I would like to know from gentlemen, and especially from those who live north of Baltimore or New York, and in that latitude, how deep they are in the habit of putting their pipes under ground. My own experience is that it is largely to be attributed to a desire to save expense in the laying of pipes.

Mr. Sherman—I would like to inquire of Mr. Jones if, in the preparation of this paper, he gave any consideration to the matter of leakage, or the loss which we are subject to through our consumers' meters. In my opinion we are subject to a very heavy loss in that way. I know of a company in New England which reduced their leakage from 20 per cent. down to 6 by merely looking over and repairing their meters. They had been very much neglected, and, in fact, no attention at all had been paid to them for years; but, by going over them and weeding out those which were not registering at all, and those which were registering 10, 20 or 30 per cent. slow, they succeeded in reducing their leakage from 20 to 6 per cent. My own opinion is that we furnish most of our customers with their night lamps without any pay, that most meters do not register the small quantity which our customers use for night lamps, and that would account for quite a leakage. There is also a great deal of gas which is surreptitiously used. All those things count against the superintendent or manager of the works as leakage.

Mr. Jones—I believe that an average test of all the meters in use in New England would be against the gas company. That is they would show slow. I have a company now in mind who are testing all their meters, and they find them slow. A great many meters are 100 per per cent. slow, and others are 10, 15 and 20 per cent. slow. In the aggregate they amount to a great deal of gas which the company loses.

Mr. Starr—I heartily agree with Mr. Sherman's idea with regard to the leakage of gas. I do not believe that the leakage of gas in the ground is one-twentieth of what it is claimed to be. I believe that one great cause of leakage is the defective meters; and another cause of leakage is the fact that almost all street lamps burn more gas than they are rated at. I believe that I lose on my street consumption from 15 to 20 per cent., because of the underating of the burners. I would rather give the people good burners than to give them small ones. My people pay me my price and I think that I ought to give them a light to suit them. They all say that they have the best lights on our streets that the lamps give anywhere. It answers a very good purpose if you want to renew your charter. We laid a street railroad in our town a few days ago and found a few places where the earth was filled with gas. I thought that there must be a big leak there; and I dug up a number of joints, but there was not a leakage that would burn. We could not find a single point where there was leak enough to show, but still there was a leakage there. I am satisfied that if you have leakage enough to burn even one foot per hour for 24 hours, it will smell on top of the ground. You cannot find a spot in our place where you can smell the gas leaking on top of the ground unless you make a cut. I am satisfied that the leakage goes in the way of imperfect meters, and through these under-rated lights on the street. A case in point occurred last Saturday. A German came to me and said, "You know that I never kick about my gas bills; but I don't know how it is that my bill for last month's gas was $2.50, while this month it is $5.00." Said I, "The only trouble is that you have got a new meter. The old one leaked." The new meter is measuring correctly, and of course the charge is very much larger.

Mr. Littlehales—My own experience corroborates what Mr. Sherman has expressed. I am convinced that a very large percentage of leakage arises from the meters, especially where dry meters are used. We know that it is no uncommon thing for us to find a meter which has ceased registering entirely. That registration does not stop all at once, but it gradually begins to run slow and finally ceases to register at all. Recently I tested a fifty light meter which had been in operation for five or six years, and I found that with five lights it did not register one foot, while with ten lights it was about 20 or 25 per cent. slow; and yet when the maximum quantity was on it was all right. Of course you can understand that in such a case a great deal of the loss would not be leakage in the proper sense, but simply that you are not getting paid for what you deliver. This loss is due merely to the defective nature of the meter; and it must be so from the very nature of the construction. Of course a careful periodical examination of the meters will remedy that. The company with which I am connected is subject to a law which provides that every meter must be tested by the Government Inspector every five years. That law has had the effect of giving us a closer examination of our meters; and I think that our small leakage account is largely due to that fact. There is another company that I know of where a great deal of gas is lost because it is overlooked; and that is on account of an old gasholder. Those of us who have gasholders exposed will find sometimes in the summer time that one side of the holder is so hot that you cannot bear your hand on it, while on the other it is colder, and at the bottom of the holder the water perhaps stands at 40° or 50°. You can easily see that there is a great amount of strain on the holder under those circumstances. There are a thousand-and-one joints and tens-of-thousands of

rivets in the holder, and there is a constant tendency to wrinkle the parts one against another; and an enormous amount of gas is lost from the holder which we do not fully appreciate. I was running some large holders awhile ago, and I venture to say that the leakage from those holders would amount to tens of thousands of feet annually. Of course, unless you get near the holder you may not notice the escape, because gas, being light, rises up. But I think that that is one large source of loss. I think that as between the holder and the meters the loss is due; and that if those two points are attended to the leakage might be brought down to very reasonable limits.

Mr. Lindsley—I would like to ask Mr. Jones how these cement joints are affected by changes of temperature. There is certainly a change in the length of every pipe by reason of the changes of temperature. I would like to know if his experience has been sufficiently long to enable him to give us any account of the amount of breakage there would be in those joints.

Mr. Jones—In my experience I have never known a cement joint, when properly made to draw. I have never known a properly made cement joint to leak. I have had dozens of cases where the pipe has broken back of the socket without starting the point on the outside of the joint. About six years ago I had occasion to lay about three-quarters of a mile of 6 inch pipe. I instructed my street foreman to lay the pipes as I have described, with valves every 500 feet, and with a lead joint on one side of each valve. The following winter I had two breaks in that 6-inch pipe and main; I dug down, found the pipe parted and was obliged to use clamps, but no joint had started; I then asked my foreman if he followed instructions; he said that he had not; that he had made that entire length of 6-inch pipe with cement joints, and it was perfectly rigid, but it parted in two places. I dug down to every valve in that length of pipe, ripped those cement joints on the valves made lead joints and have not had any trouble since.

Mr. Anderson—I would like to ask Mr. Jones if he considers two parts of cement, mixed with loose sand, makes a sufficiently strong joint?

Mr. Jones—I have found that a mixture of one part of Portland cement, one part of sand, and two parts of common cement makes a very strong mixture, and it has given me exceedingly satisfactory results.

Mr. Anderson—Can you tell what is the tensile strength.

Mr. Jones—I have never had an opportunity to test that or to get at the true tensile strength of it, but I would suppose that it was more than cast iron, from the fact that iron pipe breaks back of the socket in various places while the joint does not start.

Mr. McElroy—You are all aware that in the city of Pittsburgh we use the natural gas very largely, and one consequence was that last winter a year ago I had 300 breaks in my main. In those 300 breaks I had one cold joint, and that was at the wall of an old building that extended into the street, and in laying the pipe the men had not taken the wall away, but laid the pipe upon it, and the consequence was that the pipe had fallen on both sides and had cracked at the joint. That was the only leaky joint of the whole 300 cement joints that I had. My joints are laid with pure Portland, Rosendale, Hawthorne brand cement. I have made joints of the same kind for water pipes, where they have stood a constant pressure of 95 pounds for 9 years and never broke. I have removed, I suppose, from 11 to 12 miles of pipe with lead joints, simply because they were lead joints. I could not endure the stink on the street because of the leakage that came through the lead joints. We could not possibly keep them tight. Any person who has been accustomed to laying lead joints for natural gas in the city of Pittsburgh or vicinity, well knows that there is not 1 in 10 that does not leak. I defy any man to keep a gas pipe joint made of lead for three years. For natural gas I have laid 1¼ miles of 10-inch pipe with cement joints made in the usual manner. The company then sold out to the Philadelphia company and that pipe remained for 22 months, delivering gas at their usual pressure. Their manager dug every joint of that pipe from beginning to end and soap-sudsed it, and did not find a bubble. They simply covered up the best of my cement joints with asphaltum and paved the street. Since they did that they have dug out every joint, dug out the cement and filled them with lead, simply because they did not want that kind of evidence in the city that a gas joint could be made tight. [Laughter.]

Mr. Young—I think that it has been established beyond a doubt that a cement joint is the tightest joint yet made; the only question with me is as to its breakage. They are so rigid that there is no give to them; and unless there is a lead joint put in every three or four hundred feet, especially in small pipes, you will have a great many breaks. The question is whether it is better to have a great many small leaks than one large leak. My own opinion is, that I would rather have a large broken pipe than a thousand leaking joints. We use nothing but cement. In natural gas it is a little different. There is no trouble about making joints perfectly tight, but if, from any cause the joint is broken in any way, the slightest leak, no matter how small it is, if the natural gas gets in contact with the cement it reduces it to a powder and takes the joint entirely out. In some districts or sections from where the natural gas comes it carries a certain amount of choloride of sodium, and when that comes in contact with cement it reduces it to a powder. That has been our experience with natural gas. But for illuminating gas it will not act in that way. For illuminating gas I think there is no doubt that the cement joint is the tightest joint yet made.

Mr. A. C. Humphreys—This is certainly a very serious subject, and is worthy very full discussion. I am sorry that I was unable to listen to the paper, but shall certainly take great pains to read it carefully. I think probably this is the most serious subject that we have before us as gas engineers, and is perhaps one that we lose the most money in. I should imagine that the first thing any of us would do before starting in to find any heavy leakage would be to determine whether there was a leakage there or not. Undoubtedly, we have losses from the incorrect registration of meters, and through the incorrect estimation of the amount of gas burned in the city lamps, and from many other causes; but I suppose that the first thing we would do, and certainly we should do it, would be to start out to find what was the absolute leakage, even taking into account the condensation and shrinkage—if we may use the term "shrinkage" to denote what Mr. Jones has covered in his paper, and "condensation" to cover the actual deposition of hydrocarbons in the main. Those two points can be determined. After that it remains to determine where the leakage is, and to stop it. It seems to me that if there is any fair amount of leakage, after we determine those points, it would pay us to go right back and put our money into a systematic investigation of the condition of the mains. I do not think we want to be misled. Mr. Sherman has pointed out that possibly the trouble may occur almost entirely through the meters. I do not think we want to deceive ourselves in that respect. There is no doubt that in some localities almost the entire trouble is due to that. I have in mind a case where we took hold of a certain works, and the leakage was simply outrageous. We investigated all the points that have been referred to, and came down to a place where we thought that we were simply considering the leakage proper. We investigated the quality of gas sent out, the loss due to condensation, to shrinkage, etc., but there was one point that we did not cover at one particular station where there was an outlying holder. We did not investigate that ground, but afterwards found that there was some leakage there. In spite of all we did we still had a very large leakage; and although we went over all those mains foot by foot with drills, and stopped up very leak that we could find, we still had a very heavy leakage account. Therefore, I claim that we do not any of us want to comfort ourselves with the idea that we have not got an actual leakage account simply because our noses do not detect the leakage.

Mr. Young—I think that there ought to be a correct register kept of the temperature of the gas going into the station meter every day. I think in many cases, especially in small works, that the gas goes to the station meter at a very high temperature, and in that case the leakage would be very large. It is unaccounted-for gas. While it may not come under the head of leakage it is due to shrinkage.

Mr. Scriver—I would like to ask the gentleman from Pittsburgh what cement joint he uses and what depth of cement is used—that is, what is the depth of the socket?

Mr. McElroy—Ours runs from 4½ to 5 inches. The socket of the 4 inch pipe is about 4 inches deep; you can make a very good joint on 3 inches, but we prefer 4 or 5 inches.

Mr. Scriver—Do you use any red lead?

Mr. McElroy—No.

Mr. Scriver—What is the depth below the surface of the ground?

Mr. McElroy—From three to four feet, according to circumstances.

Mr. Lansden—It seems to me that this question is always coming back to that of contraction and expansion. The real question is how to overcome it, and how to lay our pipes deep enough so that the temperature shall not affect any kind of joints, either cement or lead. I have tried both kinds. I have taken up lead joints when I have found the lead drawn half an inch on each joint for three blocks. That was in the winter time. I have lifted those same joints in the summer time and found that they had crowded back. As my friend says, the cement joint is rigid, but your pipe has got to contract and expand. The question comes up, which is the best? The cement breaks your

pipe, and the lead lets your pipe contract and expand. I should prefer to have the joints draw. Of course in a lead joint we depend a great deal on the packing that is put in—more in fact than we do on the lead or cement. I prefer that a joint should draw rather than have a pipe break in the winter time when it is hard to dig in the street.

Mr. Gilbert—One word more on the subject which I alluded to when up before. This whole discussion shows that no matter what your joint may be, it is the action of the temperature and frost on the pipes that does the mischief. It is not essential whether the joint will draw, or whether the pipe will break, but what we want is to get the pipes so so far down that the frost will not act upon them. That is the conclusion I have come to. Our friend from Pittsburgh says that he puts his pipes from 3 to 4 feet deep. Now I submit that those who live in a latitude north of this will not protect their pipes against the action of frost by putting them at that depth. It seems to me that that is the remedy for all the trouble—to spend a little more money in putting the pipes down a sufficient depth. There is another thing which should be considered, and that is the fact that wrought iron service pipes will in many soils corrode so that in 10 or 15 years there will be a leak. For the last few years I have made it a point to encase every service pipe in a wooden box with asphalt covering. Do this, and in ten years you will see the benefit of it.

Mr. Jones—I must say that I have had the best results with mains laid in the frost—that is, with shallow mains. I have found from the Report of the Underground Temperature Committee of the British Association, that the point where a constant temperature is reached underground is 50 feet below the surface. Between that 50 feet below and the surface there is a constant working going on, caused by the change of temperature of the soil; and anywhere in that 50 feet a lead joint will be affected more or less, so as to leak to a considerable extent. From each square centimetre of the earth's surface there issues every year 44.4° of heat. Now, if pipe is laid at a point underground, say three feet deep, and the frost is 3½ feet deep, this heat—the internal heat of the earth—is issuing through the surface and striving to bring about an equilibrium. If our overground temperature rises, it gives the underground temperature a chance to exert its force. Therefore, the frost comes out from the bottom, not from the top. The underground temperature—the internal heat—is what takes out our frost, and not the temperature from the top. As the frost lets go of that main an expansion takes place. Perhaps the next night it is relaxed; the overground temperature is lowered so that the frost is driven down and overcomes this underground temperature. The frost is lowered one foot, perhaps, and takes hold of the pipe again; and the working of the frost back and forth on the cast iron pipe is, I think, more the cause of breaking than the simple expansion and contraction caused by freezing and thawing. Therefore, I attribute the good luck I have had with shallow mains to the fact that they are in the frost all winter.

Mr. Prichard—It seems to me that, taking the average temperature of the year as a factor for estimating the shrinkage of the gas, you very largely overestimate; because the selling temperature of the gas is rather the temperature of the cellar than of the earth, which my observation indicates to be very nearly 60°. It seems to me that if the temperature of the gas at the station meter is about 60°, we drop that factor from the calculation altogether. The temperature of cellars in our locality is certainly not down to 49°, and if we estimate our shrinkage as the difference between 60° and 49°, we overestimate it.

Mr. Ellice-Clark—There are many thousand miles of cement joints laid in England, and I imagine that the average depths of those would be about 12 feet. I venture to say that there is not half a mile of water tight joints so laid in England. We find, either from the carelessness of the workmen or from variations of temperature, or from some other difficulty, that it is impossible to get a water pipe tight with cement joints. For that reason at the present time in England cement joints are being generally abandoned; therefore, it is a matter of considerable engineering importance to know how a perfectly tight joint can be obtained in cement, and what is the practical way of accomplishing it, especially as cements vary so much. The cements of England are different from those of Germany. In Germany the cement manufacturers have adopted a standard as to the amount of free lime, as to tensile strength, weight, etc., but in England every engineer has his own specification; so much so that one cement manufacturer recently told me that he was working to 28 different specifications. I would like to know what rule is adopted in this country and how this joint is made so as to get it water tight. What standard of tensile strength is adopted for cement, and how it is put in place—whether in liquid shape or put in with a trowel?

Mr. Jones—I will endeavor to explain how we make our joints in South Boston. We find soft yarn, instead of old tarred ropes, better and cheaper in the end. We make a twist of the yarn, which requires to be driven in around the pipe with a caulking iron and hammer. After that yarn is driven home we take this mixture of common cement and sand and mix it thoroughly dry before we put any water with it. Then we thoroughly mix it with water until it obtains the consistency of mastic, so that it can be used on a trowel. That cement mixture is caulked into the joint with a wooden caulking tool until the joint is full, and until that cement has entered into and been driven into the yarn so that it becomes a part of it. Then, after filling that joint full of cement mixture, another twist of the yarn—the same size as the first—is entered and carefully driven home, not driven too much on one side at first, so as to drive out the cement from the other side of the joint, but it is carefully driven in alike at all parts of the pipe. After that yarn is driven we fill the joint again to the edge of the socket and clean it off and point it. As my forman says, if the joint is not tight when that first yarn is driven and filled with cement it never will be tight.

On motion of Mr. Harbison the thanks of the Association were voted to Mr. Jones for his very able paper.

The President—We will now take up Mr. Walton Clark's paper.

Mr. Walton Clark, Philadelphia, Pa., then read the following paper on

FUEL GAS.

Within the last few years there has developed a demand for a combustible, safe, cleanly and cheap; suitable for general distribution; applicable to production of light and power, as well as of heat; ready for instant use; requiring no storage room upon the premises of the consumer, and brought without his aid to the point of combustion. To state the condition of the demand is to prove a gaseous fuel necessary to its satisfaction, and I understand "Fuel Gas" in the meaning of the committee who selected me to open the subject at this meeting, to be such a gas or mixture of gases, luminous or otherwise, as is fitted to fulfill them. What I have to read to you is written with this understanding, which precludes the consideration of local plants for the manufacture of gas to be used on the premises. I confine myself, therefore, to the presentation of my ideas upon the subject of the manufacture and distribution of such gas as I believe will commend itself to our probable customers, and meet the reasonable expectations of profit which our employers may indulge, hoping to show rational ground for the faith that is in me.

A year and a half ago, I prepared a paper for the Western Association upon this subject. In it were given the ideas I then held, and now hold, as to the part of the demand for fuel we may hope to supply through pipes from central stations, and the mixture of gases which shall be at once suited to the public need and producible at a figure which shall not prohibit its sale. I now iterate the opinion there expressed, that our operations as fuel venders will be confined to warming apartments, cooking, supplying light and power, and heating soldering irons, light forgings and other implements and materials demanding a small localized fire. That we can reasonably hope to supply from our works fuel for boiler firing, metal working and other purposes demanding heat in great quantity, I do not believe. Such a gaseous fuel as will satisfactorily meet this demand, may be economically generated upon the premises where consumed, and will contain in its total bulk more of the original energy of the coal, than will a gas having sufficient heating power per cubic foot to be cheap to distribute and safe to use. Generated as wanted it will carry to the point of combustion the sensible heat with which is left the producer, a further advantage over a generally distributed gas. It not being necessary to store this gas, distribute it over large areas, or supply it cold in small quantities, the presence of a considerable percentage of nitrogen is not fatal to its use, as in the case of the gas we are discussing.

If I have not erred in this estimate of the field of fuel supply we can cover, the gas adapted to the wants of housekeepers, users of power, and, generally, consumers of fuel in comparatively small quantities, is the gas we must produce. What is this?

Among manufactured gases, not made wholly or in large part of oil, resin or other material very rich in hydrocarbons, coal gas is the ideal fuel for most purposes. With a high heating power per cubic foot, unmistakable odor and "tough" flame, it certainly answers the conditions of a successful fuel, unless we must except cheapness of production. Does it answer this condition also? It is said that in some favored localities, coal gas is being put into the holder at a cost that would enable the makers to sell to fuel users for a price lower per unit of energy than that at which a mixture of coal and other gases could be supplied, if its use were made general. Coal gas in the holder at a low figure, argues one or both of two conditions—low cost of soft coal,

high price of coke. The cheapest gas will be made where both conditions exist; and this can only be where there is a demand of smokeless fuel, and a high selling price on anthracite. Were coal gas generally adopted as fuel in such a locality, the amount of coke put on the market would be increased at least five fold, and at the same time a considerable part of the demand for it would be met by gas. With its field in part taken from it, and its own quantity largely increased, the price of coke must fall until it reaches a point at which it can compete with soft coal, for the purposes to which the latter is adapted. The amount thrown upon the market will force it from the position of a special fuel, commanding a higher price because it better meets the wants of certain consumers than does soft coal. I believe that with their present make of coke, few gas works do not at times accumulate a large stock. Multiply the make by five or ten, and can we doubt that the selling price must be very materially reduced to enable its owners to dispose of it? And if we take from the manufacturing accounts of the companies making this cheap gas the credit due to this most important residual, can coal gas then be generated at a figure justifying its sale at a price to compete with the cheap coals from which it is made? A careful consideration of the question, will, I think, convince us that we cannot afford in generating our gas to manufacture a bye-product to compete with it in the fuel market.

I admit that there may be cities in which the demand for furnace coke for manufacturing would equal the supply after the general introduction of gas had increased the coke output. In such localities, if any exist, coke might advantageously be made in ovens, and the bye-product, gas, purified and stored for distribution at a low cost. The few exceptions to the general rule do not, I think, affect the force of my argument.

As it is bad business policy to produce two commodities which shall compete with each other for a market, and as soft coal is the raw material suitable for conversion into gas, most plentifully and widely distributed over the world, we seem compelled to adopt, except in special localities, a method of manufacture that will convert this solid coal into a gaseous fuel, without the production of another substance applicable to the same purposes.

I look for no contradiction from any source when I say that unless there is in another course some object to be gained in the direction of more complete conservation of the energy of the raw material, or lower cost of production, which shall compensate for the attendant disadvantages, it is desirable that our product contain all the gas that may be distilled from the coal and resulting tar, with as much combustible gas as can be made from the coke, and nothing else. Such a mixture, if of coal and water gases only, would have a heating power per cubic foot somewhat less than two-thirds that of coal gas, (400 U. about), a specific gravity of about .500, and its total heating power would equal somewhat over 60 per cent. of the original energy of the coal. In proportion as producer gas is made a constituent of the mixture, the heating power per cubic foot, and "toughness" and temperature of flame will diminish; the specific gravity, size of necessary holders, mains and meters, and the percentage of the energy of the coal in the total product, will rise. Thus, as we convert more of the coke from the distillation of the coal to producer gas, we correspondingly diminish the value of our product for each purpose to which it is applied, and increase the difficulties of distribution and utilization. The return we get for this impoverishment of our gas, and possible annoyance to our consumers, is an increase in the total energy derived from the coal. It is not safe to distribute a gas containing as much as 33 per cent. of producer gas, because of the danger of light-drafts extinguishing its flame. The additional energy we could put into the total bulk of the product of a ton of coal, by this admixture, is less than five per cent. To save this it would be necessary to increase the bulk of the gas, and, therefore, the size of storing and distributing apparatus very materially.

In the paper above referred to, I estimate the product of 2000 lbs. of soft coal made into coal and water gas as 39,000 cubic feet, representing 54.5 per cent. of the energy of the coal; and converted into coal, water, and producer gases (1-3 of the coke going to the last) at 66,000 cubic feet, containing 57 per cent. of the energy of the coal. Here the gain through the generation of part producer gas is but 2-5 per cent. Later investigation leads me to the belief that my analyses of producer gas did not do it justice, and that the gain in energy resulting from its introduction to the product will be nearer 5 per cent. The increase in bulk is nearly 70 per cent. and the flame temperature is reduced over 400°. "It is principally upon the increase of bulk and reduction of flame temperature that I base my objection to the admixture of producer gas. We must provide storage room for a portion, and a very considerable portion, of our product. The amount, whatever relation it bears to our daily out-put, will necessarily be increased in proportion to the amount of gas required to supply a given demand for heat. To supply this demand will require of the mixture containing producer gas, 60 per cent. more than of that containing only coal and water gases, and render necessary 60 per cent. more holder capacity. There is, of course, a pressure at which it will be found most advantageous to deliver this gas, and at that pressure the carrying capacity of our mains must be 60 per cent. greater for the more bulky mixture to deliver the same amount of heating power. This estimate makes no allowance for the difference in specific gravity, which would make the comparison still less favorable to the producer gas mixture." *

Since it was written the practicability of continously distilling coal in retorts, with a portion of the waste heat from the generation of water gas (a problem I was then working upon), has been satisfactorily demonstrated, with a resulting economy in manufacture, and increase in production of commercial gas per ton of coal. This will explain why I now believe we can obtain better results than I then claimed possible. Further thought upon the utilization, or rather prevention, of tar, convinces me that it can be made to have a more considerable and beneficial effect upon the product than I then allowed for.

This mixture of the three gases would contain over 30 per cent. of nitrogen, have a heating power about 60 per cent. that of the combined coal and water gas, or 40 per cent. that of coal gas. It needs no argument to prove it a less valuable fuel per unit of energy contained, than the stronger compound, and I do not deem it necessary to reason further in defence of the claim that the richer in heating power per unit of bulk a fuel gas is, consistent with economy of production, the better our prospect of customers and profit. The considerations I have presented to you have led me to the conclusion that a mixture of coal and water gases, in the proportions which we can produce them from bituminous coal, meets the conditions of a successful undertaking better than any other possible combination, and have compelled me, in my efforts after a successful apparatus, to hold as a *sine qua non* the conservation of practically all the product of distillation, and the exclusion of nitrogen.

If I am correct in my conclusions anent the composition of a practicable fuel gas, I may now ask, and endeavor to answer the question, "What are the conditions that a perfect process must fulfill in its productions?"

1st. A portion of the combustible constituents of the coal must be burned to supply the heat absorbed in the generation of the gas. The remainder should be present in the product.

2d. The coal thus consumed should leave the apparatus as carbonic acid and steam.

3d. The sensible heat of the escaping gases should be utilized to preheat air or steam, and be so carried back into the apparatus.

4th. Radiation from the apparatus should be at a minimum.

5th. That part of the gaseous product of the coal having the highest heating power per unit of bulk should be present in the commercial gas.

6th. The raw coal should be subjected to the highest possible temperature, from the moment it enters the apparatus until the last distillable portion of the hydrocarbon gases and vapors have been driven from it.

7th. The tar made should be converted into gas, as far as possible before condensation, and as a means to this end, the water gas, hot from the producer, should be passed over the coal being distilled.

To my mind the above conditions can only be fulfilled in an apparatus providing for the distillation of the coal in a vessel isolating it from the gases generated in the combustion necessary to the supplying of the heat of gasification. Whether this vessel be of that form we are accustomed to call a retort, or not, whether horizontal, vertical or inclined, receiving coal by the shovelful or the ton, for the conservation of the coal gas made in it, its contents must be kept from contact with any gas not intended to become a part of the commercial product. I am aware that insistence upon this point precludes the use of any simple cupola process for the manufacture of fuel gas for distribution.

To fulfill the conditions I have considered necessary to a perfect process, it is essential that the coal-containg vessel should be heated by the combustion around it, of a practically continuous stream of the otherwise waste heat of the process. I am aware that insistence upon this point precludes the use of an independent fire for the coal distillation.

It is further necessary for the fulfillment of the conditions named, that the coal gas as made should be at once removed from the apparatus, and not brought in contact with any incandescent material other than the sides of the containing vessel. I am aware that insistence upon this point precludes the adoption of a plan involving the passage of the gas through masses of hot coke for its so called fixing.

* From previous paper by author.

It is necessary to the generation of a product having the greatest heating power per cubic foot, consistent with conversion into gas of all the combustible constituents of the coal, that the waste or blast gases resulting from the combustion of that part of the coal supplying the heat of gasification, should be as poor in carbonic oxide as a proper regard for the conditions essential to the generation of a good quality of water gas (principally depth of fire) will permit, and contain almost no hydrogen. I am aware that insistence upon this point precludes the generation of a producer gas suitable to meet the fuel demands of manufacturers, as a step in the process of fuel gas making. In this connection I will at once admit, that, in a locality where a considerable amount of producer gas can be utilized so near the generator as to reach the point of consumption hot, and there is an opportunity, very limited in proportion, for the sale of fuel gas, it would perhaps pay to run one apparatus for the satisfaction of both demands. The admission of steam to the generator during the period of "blowing" preparatory to the water gas making, and the consequent reduction in the quantity of the latter, in proportion to the enrichment of the blast gases, makes in this process the distributable fuel gas little more than a bye product of the generation of producer gas, but if the sale of the fuel we are considering is destined to reach in its proportions the expectations of most men who have given thought to the matter, it is to my mind folly to consider any plan which has not for its object the conversion into a distributable gas of the greatest possible proportion of the energy of the coal. In a properly arranged and proportioned plant there will be work enough for the products of combustion from that part of the coal which must be burned to supply the energy necessary to the conversion of the rest of it into gas. Due to our inability to make water gas or distill coal, except at high temperature, the carbonic acid resulting from the combustion referred to, will leave the apparatus, carrying much heat, and may be accompanied by a small proportion of carbonic oxide. The heat, sensible in each, and resulting from the combustion of the latter may be used to preheat the air necessary to the operation of the apparatus, and the steam used in generating water gas. Where mineral oil is cheap, the excess of heat in the blast gases can be utilized to distill a portion of it, with the desirable result of an increased heating power per cubic foot, of the product, and the further advantage of giving to the gas a serviceable illuminating power. Localities possessing both soft coal and mineral oil, each cheap, are favored beyond all others, as viewed by a "Fuel Gas Enthusiast." He could there hope to make an ideal gas cheap enough for use as a fuel, and so rich in hydrocarbons as to produce a satisfactory light at low cost without the aid of special appliances. Where there is no opportunity for the application of the waste heat to the distillation of oil, there is work for the greater part of it in connection with air and steam, as indicated above.

If 45 lbs. of coke is sufficient for the generation of 1,000 cubic feet of water gas in an apparatus built to fulfill, as far as the imperfections of workmanship and a proper regard for capital account will permit, the conditions I have given as in my mind essential to a perfect process, 2,000 lbs. of soft coal should yield, according to its quality from 40 to 45 thousand cubic feet of gas, having a heating power of 375 to 400 units per cubic foot and representing 60 to 65 per cent. of the total energy of the coal. As arrangement for preheating the air used in the process were perfected, or other improvements reduced, the consumption of coke per 1,000 feet of water gas made, the product would be increased in total bulk and energy. This would result in a slight reduction in the heating power per cubic foot, because the water gas has a heating power below that of the commercial mixture.

Whatever process is adopted in the manufacture of fuel gas from soft coal, having for its aim the conversion of all the combustible material to gas, either waste or commercial, a portion of the coal must be burned to supply the heat necessary to produce the change of form. I admit that this can be accomplished with less loss of heat through radiation, in a simple generator process than in an apparatus which the accomplishment of the end I aim at would demand, but in such simple cupola process there is of necessity a mixture of blasting with coal gas, involving a loss to the final product of the best part of the material, or a mixing with it of nitrogen or carbonic acid, or both. This fact is not affected by any ingenious application of exhausters, or the use of up, down, or alternating drafts. Such a process, comprehending this loss, is under obligation to show as an offset to these palpable defects some compensating economies or confess its own weakness. The disadvantages of an admixture of nitrogen are so serious that, between the horns of the dilemma, the operator of this process must choose to sacrifice some of the gases resulting from the coal distillation. This means serious loss, not only in the waste of gas, but in the consequent reduction of the heating power per cubic foot of the product.

There are many reasons why it is advantageous to the users of gaseous fuel to have it delivered to them at pressures considerably in excess of those usually prevailing in the gas mains. It is not perhaps necessary to enumerate these. One only I will mention; that is the increased duty of lamps in which the illumination results from the incandesence of material woven into the form of a "mantle" or "cage." The increase in efficiency extends to both lamp and gas, and is the result of localizing the combustion by increasing the intimacy of the mixture of air and gas before reaching the burner tip. The "mantle" or "cage" under these circumstances is more highly heated, and therefore more brilliantly incandescent with a correspondingly increased duty; and the gas being more completely burned while within it, less of the resulting heat is wasted and the efficiency per cubic foot is increased.

The improved result is effected without any increase in the amount of gas used, or shortening of the life of the lamp. The total area of the gas inlets is reduced for the increased pressure and there is practically no more wear on the incandescent material. I mention this instance of the desirability of comparatively high delivering pressure because of my belief that lighting by incandescence is to be one of the potent causes of the success of fuel gas. That a most satisfactory result may be obtained with a non-luminous gas has been established. With the mixture of coal and water gases I have been considering, I believe we have in incandescent illumination a competitor of the electric light that has the advantage of it in color and price, and is less liable to the objection of heat than the open flames we now generally use.

The disadvantages of the use of high pressure are perfectly well known, and I believe as easily overcome. The increased tendency to leakage must be met by greater care in the laying and maintaining of conduits. The danger from breaks can be obviated by the use of automatic valves. Such pressure as it would be necessary to carry to satisfactorily supply all consumers, and enable them to operate at the maximum efficiency, such appliances as they would be apt to use in burning the gas for heat or light, would not at all imperil the integrity of the pipes or joints. Not more than 10 inches water pressure or less than ½ pound per square inch would answer all purposes. I have put miles of mains and services under an air and water pressure of over one hundred pounds without any effect beyond the discovery of rusted out services and defective joints. I do not think any one will question our ability to so lay cast iron, bell and spigot pipe, that the leakage account will not be excessive with 10 inches pressure. The advantages of high pressure are the greater range permitted the consumer in the utilization of the gas, and the larger carrying capacity of the mains. A pipe will deliver twice the amount of gas at 10 inch pressure as at 2½ inches. The fact that any leaks existing would be more readily detected and stopped, is an offset to the disadvantage of greater liability to leakage. Meters as made by first class manufacturers can be trusted to properly measure at 10 inches pressure.

In the paper already referred to, I gave the efficiency of gas cookers and heaters as varying from 32 per cent. to 77 per cent., quoting Mr. Travers, of the British Gas Institute, as my authority. A long series of experiments made last winter, by Mr. Carter H. Page, Jr., for the company which employs me, gives a lower efficiency for cookers. The work was done with stoves from eleven makers, all about the size generally known as 7B; and consuming between 30 and 40 cubic feet of gas per hour each.

The efficiency of the various burners was from 14 per cent. to 52 per cent., and the maximum (in which we are most interested as indicating the best result so far attained) was 55.4 per cent. The average of all burners of the eleven stoves was about 22 per cent., and of all burners of the best stove under specially favorable conditions about 38 per cent. It is only fair to the gas to state that no efforts were made in this series of tests to provide for the recovery of waste heat. The stoves were just as the makers put them on the market.

I am pleased, in view of the above figures, to be able to say that there is much room for improvement in gas stove construction.

In comparing the efficiency of fuels it is only fair to consider the work done with the best appliances obtainable. With the best stove at his command Mr. Page obtained an efficiency of 38 per cent. in an experimental test. Afterwards, in cooking meals for five persons, he found the efficiency reduced to 29.8 per cent. With a good coal range he obtained an efficiency of 3.36 per cent., starting, as with the gas stove, all cold, and cooking three meals a day. In each case care was exercised to prevent waste. In these tests the gas has the advantage of intermittent use, which it would lose in the case of heating stoves or furnaces kept alight night and day. In such work the advantage of gaseous fuel, though still very considerable, would be much reduced.

Discussion.

The President—Mr. Clark's paper is now open for discussion. As

Mr. Loomis has had considerable experience with and has given considerable attention to this subject the association would be glad to hear from him.

Mr. Loomis—I have carefully read this interesting paper on the subject of fuel gas, and there is a great deal in it that is undoubtedly of great use. Some of the things I will mention. The quality of the gas, which he proposes to distribute according to his scheme, makes it an ideal gas. It is a gas which we should all aim to make. It is practically a gas consisting of water gas and coal gas. It should be made from the same machine, and well mixed together without any admixture of producer gas at all. There seems to be the idea in some sections that I am in favor of mixing producer gas with water gas for street distribution. My idea is to build generators that will make a mixture that will answer for every purpose; that is, a mixture of gas for different uses. A machine must be made for making gas for manufacturers' use, for distributing it in the streets, and for doing different things—a machine that will make any kind of gas that is practically needed for the purposes that it is to be used for. In some metallurgical work and in some manufacturing establishments, a mixture of different gases is superior to either of the gases used alone—that is, a mixture of producer gas and water gas. In other uses the producer gas is superior for certain purposes. The flame temperature of water gas if mixed with it is too high. It makes a certain heat for some metallurgical works which cannot be used, and it has to be eliminated. What you are most interested in is the manufacture of gas, not for metallurgical works, but for general distribution in the streets. For all purposes, as I said before, the gas that Mr. Clark proposes should be made for that purpose is, according to my idea, as nearly a perfect gas as can be made. Perhaps the units of heat may be too large, that is, there may be too much of volatile matter in it to burn without having any Bunsen burner to give air. I think that fuel gas for domestic use should be burned in an open burner, because, as you know, it is impossible to burn these gases thoroughly in a Bunsen burner without varying the pressures, or varying the draughts of air. By mixing a large quantity of water gas with a certain amount of coal gas you get a high flame temperature which will burn in an open flame burner. In regard to the matter of pressure he is right. The first works that I practically built were for metallurgical uses, at Turner's Falls, Mass. I built a holder with 16 inches pressure, and we can use it down to 10 inches. The next I built with 10 inches, and we found that with that 10 inches pressure, for matallurgical purposes, better results were obtained than from either a higher or lower pressure. In some part of his paper, Mr. Clark says something with regard to producer gas, which it seems to me is based upon a mistaken idea with regard to its value or quality. Producer gas, if made with the style of blast furnaces or cupolas that are mostly in use in making water gas, is partially burned or destroyed in the making. That is, while blasting, air is carried up by the peculiar shape of the furnace, and the gas is partially burned while passing up the side of the furnace, and after it reaches the top the hydrogen is liable to be burned out of gas, and it is reduced in quality, and contains not more than 60 or 80 units of heat, and sometimes as low as 50 units per foot. A producer gas made from soft coal should have about 120 to 130 units of heat. If the tar and all the heavy matter is made into fixed producer gas, then we have a gas which we can transport and burn at any distance from the generator with the sensible heat eliminated. The sensible heat is worth more to use for producing steam for running the apparatus than for any other purpose whatever. I am going to make a statement now that perhaps will bring up some discussion, and it is this: The sensible heat in gas we do not find of much advantage in furnaces, and it is better to utilize it by heating water, or by heating air to burn with it. If air is heated and mixed and put in the furnace good results are obtained. We made a number of tests with heating gas with waste products from a furnace, and on waste products from forges, and found that heating the gas up to 300° to 500° we got no practical reduction of the amount of gas consumed. In the same forge we treated the air in the same way, mixed with the gas, and we got a large percentage of saving. The reason that we get a larger percentage of saving in heating air, more than we do in heating gas, is because the air is expanded in the heating of it, and the gas mixes better with it and it is better ignited. Now, with regard to the sensible heat in producer gases. At a meeting of the Iron and Steel Institute of Great Britain, several weeks ago, this matter of gases was discussed thoroughly, and Mr. Head, an engineer in the employ of Sir Frederick Siemens, made a statement to the effect that they had made some experiments on that line, and had taken gases and cooled them purposely, after leaving the generator, and burned them in a regular Siemens regenerative furnace; and that they got better results in this way than they did by taking the gas directly from the producer. He gave no reason for it; it was a mere statement of what he found out by experiments. There were a number of able engineers there at that time who expressed the same view. I am not making this as my own statement, but merely to show that producer gases have been cooled and can be cooled, and that they are not obliged to be used exactly at the place where they are made, but can be carried any distance, whether one mile or 100 miles. It is only a matter of the size of the pipe, and the gases can be used with great economy at various places. Works can be built and producer gas made and carried up into a town for heating, or carried to large works for metallurical uses, or used for heating buildings or for any manufacturing purposes whatever. In making my producer gas I use no more of the coal than is used in any other process. I make as much water gas and coal gas mixed together as any process which is to-day running, or that is ready to be tested; that you can all see for yourselves. It is only a matter of investigation of the plants which I have built, and which are open to inspection by you at any time, and I will be glad to have you see them.

Mr. Denniston—I was asked by the Secretary if I could not prepare a paper on fuel gas, and I said I thought I would. At that time I expected to have the process in operation so that I could give you my experience, but I have been unfortunate in that, and have not had it in operation. I have, however, given some little attention to the subject, and have made some attempts at it. I certainly feel under obligation to Mr. Clark for the very clear statement that he has made, and I think that his paper is well worthy the careful consideration of gas men. I differ somewhat with our President, who this morning stated that he did not think that it was worth our while to attempt to make fuel gas. Possibly I misunderstood his language; but from hearing his address read I thought he stated that there had been so little success attending it so far, that it was hardly worth our while to make an attempt to make it. I hope I am wrong in this understanding, for I certainly think it is worth our while to make some investigation of this matter.

The President—I think if you will read what I said you will understand it differently.

Mr. Denniston—Then I am wrong, and stand corrected. I would be thankful to any one who would make known any plan that will secure a good cheap fuel gas; and I am glad to see that Mr. Clark is so enthusiastic upon this subject. While he may not have got all in it that could be expected, and not all that he expected to get, still he is a little better than others who claim to have it all; and Mr. Clark deserves to have success if he has not attained it. I claim that even if he has not attained it he may yet attain success; and it may be a comparative success to him when under different circumstances it might not be a success to me or to other members in different localities, or under different circumstances. I am thankful and grateful to Mr. Clark for his full and clear explanation of this new method of making fuel gas. I am thankful as one who seeks to learn something of this interesting subject, and I feel grateful as one of many to be benefited by the successful accomplishment of any plan that will insure a good and cheap fuel gas. Mr. Clark modestly and candidly asserts that many of the ideas and appliances and a portion of the processes are not either new or patentable; but success in one experiment, or success to him as he may have it, may be only comparative success as to other places under different circumstances. Two men who devote time and talent to working out a theory, or some cherished idea, when partially successful, imagine they have found it and that their plan or method of all others is the one most economical or effective for the purposes intended. Instance the many methods, patents and appliances now before the public, each claiming superiority, and yet not one perhaps that is in every respect satisfactory. Therefore, if this be not all that Mr. Clark claims for it, it will not be singular, and if it is not perfect, it, like all other improvements and new things, will lead up to eventual success. It is a subject well worthy his further consideration and, indeed, is worthy the study of every practical man, as well as of the theoretical man; and the capitalist may consistently help with his means to a final and successful financial result. I think there is no question among practical men about the possibility of making, or even about the practicability of making a fuel gas. The method of manufacture and the kind made, must determine largely both as to the cost and the utility of it. I have found in some recent experiences that an intense heat can be made from steam, oil and air, generated in an entirely different manner from this plan suggested by Mr. Clark. And that coal dust can also be used to advantage, where it can be obtained at low cost, and even that it may pay to crush nut coal and slack into dust in order to spray it into the retorts, or generators, as may be desirable, and owing to what use it may be put to. Especially would this be the case if making only illuminating gas. The heat furnished during the trial I have referred to was such as to fuse the best fire brick in a short

time, when properly applied. If not properly applied it would be of little or no value. This, however, is not singular to this particular gas, as the same may be said of any fuel gas, or indeed of any fuel; but it does not follow always that when the theory is correct the trial is satisfactory. Then, again, the practical man may succeed in the application of a principle that scientifically would be cast aside. How often have we seen labored and scholarly dissertations set at naught by some ingenious practical application, which, when seen, and it has become an accepted fact, can be easily explained, but of which it may have been asserted that theoretically it was impracticable if not indeed impossible. Therefore, it is not for me or for any one when Mr. Clark (who is qualified in a double sense), or any sensible man asserts he can accomplish certain results to say it cannot be done, until after the fullest investigation and most careful trial it has been proved a failure. I have no doubt Mr. Clark can improve on present methods, and yet it may be a success to him now. There are certainly some things to commend in his plan. I believe that for certain purposes fuel gas can be made to take the place of solid fuel, and I believe it can be made from culm or coal dust, slack and oil, or oil and steam, or by a combination of these materials; and that hot air can also be used to advantage in the manufacture of the gases in the generators and retorts. Indeed, this is no longer a matter of belief—it is now knowledge; but I believe that for certain purposes and in certain localities it can be done with profit. It has been asserted that hot air costs, in energy to heat it, all it is worth in the heating furnace, but that depends upon circumstances; if you have the heat, and it is heat that would otherwise be lost, it would certainly be of advantage to use it where heat is required, and thus utilize a waste product; and then, too, may not the hot air, like the superheated steam, be of value in aiding the formation of the gas, as well as its ultimate final combustion? I am an interested party in some new methods proposed, where this process will I hope soon be put to a practical test. Some experiments have been made—enough to show results heretofore unexpected; but a thorough test under favorable circumstances has not yet been made. Some time since a trial was made with a crude machine, where, as at Oliver Roberts' Pittsburgh wire mill, an intense heat was generated with a comparatively small amount of oil. It was there that this crude machine was operated for about a week, and was to a degree successful—so much so, indeed, that improvements have since been made, patents applied for and obtained, which it is claimed will, for iron and steel heating in reversible Siemens furnaces, prove a decided advance over present methods and produce a great heat at a comparatively small cost. Neither the plant to make it nor the gaseous fuel being expensive, it can be used as natural gas is used, with benefit to the iron or steel as the case may be. I do not claim that it can be made to supersede natural gas where it is, or in the immediate vicinity of natural gas districts; but that it can be used to advantage where coal is scarce and freights high and where oil can be transported in tank cars for less than either hard or soft coal. If an illuminating gas were wanted the same plant can be used, but only a minimum of air and steam would be used, and consequently a smaller production, which, too, would require purification. I repeat, Mr. President, that I have been pleased with the presentation of this subject by Mr. Clark, and I believe the subject will be kept before gas men, and in fact all classes until we get a good gas fuel. It is hard for those of us who have been accustomed to gas fuel to contemplate a return, even in the dim distance, to solid fuel, with all its attendant dirt, smoke and general nuisance and filthiness. We want, in fact as well as in theory, a good, safe, fuel gas—and I was going to add "cheap"; but if in other respects it is satisfactory, a high price would be paid before we would again use coal. I hope and expect to learn more of this interesting subject.

I may say, before taking my seat that I was somewhat surprised to see it stated in Mr. Clark's paper that he does not propose to discuss the fuel question upon anything but a coal basis, or upon the basis of fuel gas which can be distributed. My experiments so far have been for the purpose of attempting to get a fuel gas that could be used in iron and steel and such like furnaces, and not for general distribution. If we are successful in that, the other will follow. If you can get such a heat which was attained at the wire mill which I mentioned, and that can be proven to be successful, to such places as Pittsburgh, Chicago, and different manufacturing points, it would be of great benefit, though you might not get a fuel gas which could be distributed to the general public. As well might we undertake to distribute coal to every person throughout the West where wood is more plenty than coal. I think if we can get a manufacturing fuel gas, a fuel gas which can be used in the Siemens' furnace (as I claim this can be), that is a great point gained and these other uses will naturally follow. As to the amount of air necessary to be used, I may say that you can grade that to suit the character of the gas that you want to make. And, as I have stated, if you want to make an illuminating gas, you can leave out the air, and make it from oil alone, or by the combination I suggest. It is not made by cupolas, but by retorts; but not necessarily so, as it may be made in a cupola also. And further than this to use culm, and the waste about coal mines is another object in view where you can make this gas from cheap fuel. I think Mr. Loomis stated in his remarks that while he used air of a certain percentage it not only carries the heat where you want it, but it aids in the combustion of the gas already formed; or if you have not got a fixed gas, to carry vapor into the furnace. It may do that when it will not do for other purposes. For instance, it might not do for the manufacture of crockery ware, and such things as are glazed, for the steam would take the glazing off, whereas the same heat, made from the same products and put in a furnace for heating billets of iron or steel, would increase in amount the heat given off in that furnace. As I say I am not prepared with data which I expected to have, but hope to have them later.

The President—I think in the last six months, most of you have heard the statement made that progress is promoted by enthusiasts. We have a gentleman present, who is, I think, an enthusiast on this subject. I refer to our friend Faben. We shall be pleased to hear from him.

Mr. Faben—I did not come here to discuss fuel gas, but to listen. At some future time I may discuss with the gentlemen this subject, but I am not prepared to do so to-day.

Mr. A. C. Humphreys—I would like to ask Mr. Loomis what would be the maximum size of the outlet burner which he would use for the distribution of producer gas, and which would keep ignited under all conditions, so as to be perfectly safe. I have made some investigations in this line, and in every case where I have got on to the use of producer gas I found that the burner of the size which would ordinarily be used in a house was unsafe. In one case that possibly Mr. Loomis would be interested in, the burner was probably 2 inches in diameter, and it went out two or three times in the course of two minutes, and had to be lighted with a torch. I would also like to ask Mr. Loomis how, in the production of gas by the method which he has outlined or referred to, he would conserve all the hydrocarbons of the coal? I cannot see how he could do so. The blast goes through the coal, and how he can chain the hydrocarbons to their places to let them free in the second part of the process, is somewhat of a mystery. I think it is due to Mr. Clark to point out that there has been no effort on his part to drag in a process, but rather to point out a theory upon which we must all work if we are going to be successful in the production of a gas for general distribution. Of course there would be exceptions. Mr. Clark has pointed that out very clearly, and perhaps the clearness with which these points are stated in his paper will be more apparent upon a second reading; but undoubtedly the point is well made that we must look to soft coal for our general heating gas. That is a fuel which is scattered all over the world, whereas anthracite is comparatively rare, and oil is comparatively rare—at least it will be comparatively rare when we come to use it in such immense quantities as we would have to for fuel gas. All these points have to be borne in mind.

Mr. Loomis—A question was asked with regard to a burner for producer gas. I did not say that I would distribute producer gas to be used for private consumption; on the contrary, I say that I would not.

Mr. Humphreys—I understood you to say that it could be done.

Mr. Loomis—I did not intend to say so. What I did intend to say was that producer gas could be carried in pipes to any distance and burned in metallurgical works, and for heating large spaces or areas where it could be burned in a large open fire. I said positively that I would not put any of it in with a mixture of other gases for street distribution, and that I would not distribute it for household use, because I know the liability of any gas to go out when it has air or nitrogen mixed with it.

Mr. Humphreys—Granting the position now taken by Mr. Loomis, will he not now answer my question: What would be the minimum size of the outlet of the burner?

Mr. Loomis—I cannot say what would be the minimum size. It burns readily out of an inch pipe, but we have not had occasion to determine how small a burner we could use. We have burned it in a smaller burner, under blast. I said, to begin with, that I would not use the gas for household uses.

Mr. Humphreys—Leaving the houses out, I would like to get some satisfactory information as to the size of the burner. Do I understand Mr. Loomis to say that it would be safe for boiler purposes, or anything else, to distribute a producer gas and expect to burn it out of an inch and a quarter pipe?

Mr. Loomis—Yes, I think it would be.

Mr. Clark—Mr. Loomis speaks of the generation of producer and water gas, and the subsequent mixture of the two for some purposes. Do you mean, Mr. Loomis, the generation of producer and water gas in the same vessel, one process alternating with the other?

Mr. Loomis—Yes, sometimes we produce them at one time when the heat is in the right condition, in which case we mix them altogether, or, we make them alternately, one in one place and another in another, and then mix them. In metallurgical works, we find they do not like to use water gas for many uses—I cannot explain to you all their theories—but they say that it has too high a flame temperature, or that they want a mixture of gases of lower flame temperature. Then we have other matallurgical works where, if we do not use a regenerative furnace, we are obliged to use higher temperatures, and to use water gas pretty nearly alone. At the Waltham Watch Works they were using illuminating gas to melt magnetic alloy, and it was impossible for them to do it under an hour and a half, and sometimes two hours: but with water gas alone they can melt it in thirty minutes.

Mr. Clark—You would not expect any difference between producer gas, as you call it, and the water gas made from the same apparatus, alternating, and a producer gas made with as much steam as the coal would take, would you?

Mr. Loomis—If you put the steam in and mix it all together you make a superior producer gas. Instead of being 60 per cent. nitrogen it will run down as low as 45 per cent. That makes a good producer gas, but it is practically part water gas. It has a large percentage of hydrogen. That gas can be worked for running gas engines, and is being so used in England largely at the present time, and has reduced the consumption of coal in gas engines down as low as one and a quarter pounds of coal per horse power per hour. That, of course, is a gas that will ignite in a gas engine.

Mr. Clark—I would like to get the composition of this gas which you say can be carried to a distance and used economically in metallurgical works. By "producer gas" in that sense, do you mean air gas?

Mr. Loomis—That is an air gas. You may take nothing but air and pass it through soft coal and you can make a gas you can carry to any distance you like, and it does not condense or lose its vitality.

Mr. Clark—Will it then light cold?

Mr. Loomis—Yes.

Mr. Clark—At Tacony, a few months ago, they told us the producer gas that was made from soft coal, in the endeavor to light cold was not a success—that they could make it burn as long as the torch was held to it, but when the torch was withdrawn it would go out.

Mr. Loomis—In what part of the works was this?

Mr. Clark—In the generator house.

Mr. Loomis—Then it was blown out by the blast?

Mr. Clark—But it was what they call producer gas.

Mr. Loomis—It would burn better at a distance. It would burn better over in the furnace house, 1,000 feet away, than it would in the generator house, and for this reason, when the generator starts and begins to make producer gas, there is a certain amount of steam left in the exhauster in the lower part of the furnace which has not yet passed through the coal at all, and that steam will go out with the first producer gas, and until it has a place to condense somewhere it will pass along with the gas and put it out. The gas they lighted for you might have been in that condition.

Mr. Clark—They told me that it was gas coming from a producer holder, and I presumed, of course, that it was all right. At the Bethelem Iron Works there are a large number of Siemens generators lying idle, because they found it was not economical to carry that gas 1,500 feet to where they had to use it as producer gas. This statement was made by their assistant superintendent to me. That was not air gas: that was a gas that would probably have 50 per cent. more heating power per cubic foot. I was a gas made with steam.

Mr. Loomis—But that has no more units of heat in it than the gas which I make.

Mr. Clark—Can you explain to me how it is that a gas that is made with air only, and which consists only of nitrogen and carbonic oxide, can have as high heating power as a gas which displaces a part of the nitrogen with hydrogen?

Mr. Loomis—In the Siemens furnace very little of the steam goes into the gas. There is not as much hydrogen in their gas as there is in mine. In my gas I have from 10 to 12 per cent. hydrogen, without the admission of steam.

Mr. Clark—Where does the hydrogen come from?

Mr. Loomis—It is there. That is all I know. Of course there is a certain dampness in the coal, and percentage of hydrogen in the coal.

Mr. Humphreys—I understood Mr. Loomis to say, a few minutes ago, that the gas was richer in the case of steam introduced into the blast; but I may have been mistaken as to that. I would like to ask Mr. Loomis if he cares to answer my inquiry in regard to how he preserves all the hydro-carbons of the coal in his process, when he sends gas through the coal?

Mr. Loomis—I do not preserve all the hydro-carbons in the first two cases. We get the producer gas the same as you do. If you blast coke to incandescence, there is a certain amount of hydrocarbon in it in its first stage, and you do not get them all out. There is a certain amount of carbon that you must blow away before you can get incandescence. I don't know that I exactly understood what you wish to know.

Mr. Humphreys—What I am trying to draw out is this. That it is not necessary to waste any of the hydrocarbon to get it ready for water gas manufacturing. What I was trying to draw out is either a denial or an acknowledgment that the gas ready for general distribution (which Mr. Loomis agrees will be the gas, which Mr. Clark has pointed out as being an ideal gas) could not be produced from his apparatus and retain its hydrocarbons.

Mr. Loomis—Do you think that none of them can be retained?

Mr. Humphreys—I do not say that, but can they all be retained?

Mr. Loomis—No, I do not retain all the hydrocarbons, but I accomplish the same thing, as the heat units are saved in one way or another.

Mr. Humphreys—My question refers to the commercial gas as made ready for distribution.

Mr. Loomis—No, I do not retain them all, nor does any one else, by any process.

Mr. Clark—I have not spoken of any particular apparatus, and I want to ask you if the steps of the process which I have described in this paper will not result in a concentration of the coal gas in the final product?

Mr. Loomis—I cannot say as to that, but I think you will find difficulties such as you have not yet encountered in working them out.

On motion of Mr. Rowland a vote of thanks was passed to Mr. Clark for his paper.

Committee on Place for Holding Next Meeting.

On motion of Mr. Harbison the Chair appointed the following gentlemen to serve as a Committee to designate the next place in which to hold the next annual meeting: A. E. Boardman, Macon, Ga.; Thomas Turner, Charleston, S. C.; E. G. Cowdery, Milwaukee, Wis., G. S. Hookey, Augusta, Ga., and J. P. Harbison, Hartford, Conn.

Introducing Commissioner Barker.

The President—We have with us to-day Mr. Barker, a member of the Massachusetts Board of Gas and Electric Light Commissioners, and I invite him to a seat on the platform. We know that he is always willing to give us a word of advice and encouragement. (Applause.)

Mr. Barker—Mr. President and Gentlemen of the Association: I regret to say, Mr. President, that I did not hear the whole of your remarks. I happened to be busy talking with a gentleman when you began speaking, when I heard my name mentioned and something said about the platform. I hardly think you would care to have me take the time of the Association which might be better spent in listening to others. I must thank you, however, for the very pleasant way in which you have mentioned my name, and for the very pleasant way in which the allusion to the Board has been received. It is but one of a long series of courtesies which the members of this Association, and of some of the other Associations in the country, have been pleased to extend to me as the representative of the Board. I am very glad indeed to be able to express the cordial gratification of the Board for very many act of kindness. It has been my good fortune to visit a large number of the companies throughout the country, and I confess that I have been somewhat surprised, as well as very greatly gratified, at the cordial reception which, as a representative of the Board, has been given to me. The confidence which has been shown by the exhibition which representatives of companies have made to us of their work, and of the facts coming to their knowledge—a confidence which, I am happy to say, has never yet been betrayed—has been of very great service not only to the Board, but I trust of considerable benefit to the companies with which the Board sustains such intimate and important relations. As I have said, Mr. President, I do not think that it is wise for me to take the time of the Association which can be better spent in listening to these very interesting papers which have been prepared. I can only express to the members of the Association my profound wish for their prosperity and their success in the solution of the very important problems to which their attention is directed. (Applause.)

Mr. Harbison—Although a vote of thanks has been given to Mr. Clark for his paper, I think that we ought not to let the matter drop here. I am quite interested personally and officially in the subject of fuel gas. I do not want a gas which can be used in iron works specially, or only in manufacturing establishments, but I want one which can be distributed for general use by the public, so that the Company which I represent can enter into the business of producing it and make an honest dollar by selling it at a reasonable price. I believe that Mr. Clark has started in the right road, and that he is working in a direction which will tend to the realization of our hopes. Others may be, and no doubt are working in the same field. We shall hope that they will arrive at practical results and not simply at theoretical results. I do not care to know especially whether a producer gas can be carried 50 feet or 100 miles from the point of production. The question is, will it pay to do it? Can it be carried in connection with legitimate fuel gas or water gas? If not, then what advantage is it to us to discuss the question or to waste any time in discussing whether fuel gas can be carried that distance. Of course there can enough of it be made to be of practical value to a company engaged in the business of making and selling fuel gas. I move that Mr. Clark be requested specially by the vote of this Association to present to us, at our next annual meeting, the results obtained in his investigations during next year. I make this motion because I think the subject is one of great importance to the members of this Association, and because it is desirable to have practical results presented to us. I know that Mr. Clark, like many other members of the Association, is extremely modest and bashful, and might not be willing, without some request on our part, to come before us every year with a paper on this subject; but I think that he is eminently fitted to prepare such a paper, and I hope he may be requested

by the vote of the Association to do so, and present it to us next year. I so move.

The motion prevailed.

Mr. Clark—I appreciate the kindness of Mr. Harbison's remarks. I cannot promise that I will tell next year what has been done with the apparatus that I am at present operating, but if I am successful you will certainly hear from me.

The President—We will now listen to the paper by Mr. B. E. Chollar, of Topeka, Kan., on the

PURIFICATION OF GAS FROM KANSAS COALS.

The gas coal fields of Kansas at the present time are limited to a small district, hardly more than 20 miles long and 5 miles wide, situated in the counties of Cherokee and Crawford, in the extreme southeastern part of the State. The coal deposit is three to four feet in thickness, and is found at the depth of about 40 feet below the surface of the ground. The vein is not continuous, but considerably broken up by clay seams, commonly known as "horse-backs." The appearance of the coal at first glance is much the same as that of the product of the Eastern mines, excepting perhaps that the color might seem to incline to a brown or a dark bronze. It is softer and more friable than many of the Eastern coals, and is especially liable to disintegration from exposure to the weather. The coals as shipped from the mines, contain large quantities of iron pyrites; not only in well defined streaks, but also thoroughly permeating the whole mass. About six per cent. in weight of the coal can easily be picked out for rejection. The coal is a fairly good gas and coke producer; the average yield at Topeka for two years being 4.56 feet per pound, and the average illuminating power 17.42 candles. The coal furnishes about two-thirds its weight in coke heavily charged with sulphur, but of good heating power. The quantity of ash and clinker is fully one-eight the weight of the coke. The composition of gas in respect to the two principal impurities, is subject to very great and very rapid fluctuations. Contrary to the usual rule, the sulphureted hydrogen is far in excess of the carbonic acid; the former varying in quantity between 40 and 75, and the latter been 15 and 25 volumes per thousand. Two examinations in quick succession of the gas just before the condenser gave, respectively, 59 and 60 volumes per thousand of H_2S, to 14 and 14 of CO_2. At the same time, the gas immediately after the condenser indicated 55 volumes of H_2S and 14 of CO_2 per thousand. The general effect of the condenser is to remove sulphureted hydrogen and not carbonic acid.

In the purification of gas from these coals, the popular idea that CO_2 combines more readily than H_2S with lime, is contradicted, and the opinion is confirmed that such a theory could not have gained credence where coals similar to these were used.

The experiments next following will show the condition of the several purifiers, when the gas at the outlet of the third was about to show a foul test with lead paper.

	H_2S vols. per 1000.	CO_2 vols. per 1000.
Outlet 3d purifier	nil	3
" 2d "	10	5
" 1st "	50	10
Crude gas	48	15

The first purifier was doing good work with respect to CO_2, but was discharging into the second more H_2S than it was receiving at its own inlet. The load, it will be noticed, was chiefly on the second, which was removing 40 volumes, or fully four-fifths of the H_2S, and at the same time a quantity of CO_2 equal to that absorbed by the first one. The third purifier was removing the last fifth of the H_2S, which, under ordinary conditions, it could easily do with the presence of so small a quantity of CO_2.

The quantity of carbonic acid indicated above at the outlet of the third purifier is probably overestimated, by reason both of the difficulty of accurately measuring so small a contraction as three volumes in a thousand, and of the fact that nearly the same error of estimation is included in this small quantity as might be expected in a larger one.

What little CO_2 there was left in the gas, was probably all, or very nearly all in combination with NH_3; the gas at this point was alkaline, and required a strong flow for 15 to 20 minutes to produce a visible effect upon a solution of acetate of lead.

On the same day, after putting a fresh purifier to work, a similar examination resulted as follows:

	H_2S vols. per 1000.	CO_2 vols. per 1000.
Outlet 3d purifier	0	3
" 2d "	8	4
" 1st "	12	6
Crude gas	44	16

The purifier that was second in the previous case had now become first in the series, and it was still able to remove 32 volumes of H_2S and 10 of CO_2.

After about 200 M of gas had passed, the following result was obtained.

	H_2S vols. in 1000.	CO_2 vols. in 1000.
Crude gas at start	52	12
Outlet 2d purifier	8	4
" 1st "	26	6
Crude gas at end	51	13

The first purifier was perceptibly weakening, but still was able to remove 25 volumes of H_2S and 7 of CO_2. The second remained about in the same condition as before. The test at the outlet of the third was omitted.

Several hours before the next change of purifiers the condition was the following:

	H_2S vols. in 1000.	CO_2 vols. in 1000.
Outlet 2d purifier	8	4
" 1st "	40	6
Crude gas	50	16

The first purifier had nearly lost its grip on the H_2S and allowed 40 out of 50 volumes of H_2S to pass into the second. It was, however, able to stop 10 volumes or two-thirds of the CO_2. The foregoing experiments go to show beyond a doubt that not only does the lime take up the H_2S more readily than it does the CO_2, but also that a lime purifier when saturated with H_2S may still continue to take up CO_2.

In order further to test this matter, the crude gas was passed in a wash bottle through the several solutions enumerated below.

	H_2S vols. per 1000.	CO_2 vols. per 1000.
Crude gas at start	51	15
After carbonate of ammonia	37	33
" " " soda	7	19
" milk of lime	3	15
" caustic soda	3	14
Crude gas at end	50	14

The caustic alkalies removed nearly all of the H_2S, while they hardly touched the CO_2; while on the other hand, the alkaline carbonates actually increased the quantity of CO_2. This latter action is confirmed by the action of the washer, which, when the flow of water becomes partially stopped, not unfrequently does the same thing.

It would seem, therefore, that notwithstanding the greater affinity of the lime for the H_2S than for the CO_2, yet in consequence of the great abundance of the lime in operation, the actual absorption of both of these impurities is proportional to their relative quantities present in the gas. In the above experiments, the estimation of ammonia has been neglected.

In order, however, to find out if any perceptible error had been made by so doing, the crude gas was passed through diluted sulphuric acid, determinations of the H_2S and CO_2 being made before and after as follows:

	H_2S vols. in 1000.	CO_2 vols. in 1000.
Crude gas	42	19
After acid	41	21
Grude gas	41	22
After acid	42	22

One of two things is probably true, *i. e.*, either the quantity of NH_3 was too small to measure by volume, or it was in the form of carbonate, which, upon being decomposed by the acid, set free its own volume or thereabouts of CO_2. In either case the volume of ammonia present was quite probably not in sufficient quantity to effect the relative proportions of the other impurities as determined above.

In examining the hydraulic main liquor from the Kansas coals, two noticeable characteristics will be observed—instead of finding the ammonia chiefly in the form of carbonate, as is usually the case, we find it almost entirely in the form of chloride. So free from carbonates is it usually found that only at times will the addition of strong acid produce any effervescence. It weighs about 6° Twaddel, and indicates about 9 oz. strength per U. S. gallon by distillation.

The liquor from the condenser is very highly charged with carbonates as well as with sulphides. It effervesces furiously on the addition of an acid, and gives a strong precipitate with acid sulphate of iron. It weighs about 4½° Twaddel, and indicates about 5⅜ oz. strength by distillation. The water from the washer contains chiefly the sulphides of ammonium, with a fair share of carbonates. It weighs ordinarily only about 1½° Twaddel, but indicates about 5-oz. strength by distillation.

The removal of so large a quantity of H_2S in the purifiers produces as a matter of course a corresponding quantity of water, which drains through the lime and collects on the bottoms of purifiers. This water weighs about 3½ ounces and indicates about the same number of ounces in strength. It consists chiefly of the sulphides of ammonium and of calcium. Notwithstanding the large quantity of sulphur compounds in this gas, the practical purification of it is not so difficult a matter as one might reasonably expect. The purification is conducted entirely with reference to the H_2S; the CO_2 will cause no trouble. Effective condensation will remove the tar and help to a certain extent with the H_2S. Thorough washing or scrubbing, especially the latter, will remove no small quantity of the soluble sulphides.

In the purifiers the quantity of H_2S being so extremely large, the lime is rapidly converted into sulphides, thus providing an ample supply of material for the absorption of the sulphides of carbon—these latter compounds are well represented in the crude gas, so well in fact, that in case the purifiers fail to act properly, they have a way of showing their presence at the burner as much to the disgust of the consumer as to the annoyance of the producer.

In working the purifiers, it is best not to trust too confidently the indications of lead paper, especially at the outlet of the third box; for by the time the foul test is shown at that place, the first purifier will probably have become over-charged with H_2S, and the middle one uncertain in condition, thus throwing too great a responsibility, as it were, upon the last box. The sulphides of carbon, as is well known, give no warning of their coming, and are liable to appear at any time after the first purifier has become inactive.

A safe way to operate, particularly in winter, is by a kind of "rule of thumb;" that is to say—find out by experience how much gas can safely be passed per purifier, then to be careful not to exceed that quantity, being, however, always ready to make a change at any time, in case a foul test should appear.

The proper preparation of the lime, as well as the filling of the boxes, are matters of especial importance and should receive careful attention. With purifiers of sufficient capacity, two trays of lime, each one foot deep, in each purifier, has been found to give good satisfaction. The

average duty of the native lime is between 5,000 and 6,000 feet per bushel.

In view of the foregoing, it will hardly be denied that the successful purification of this gas demands an alkaline material. Lime is effective, but costly. Fortunately, however, ammonia abounds in good quantity in the gas, and it is not improbable that at a day not far distant the substitution of this compound for lime, together with converting the H_2S into sulphuric acid, will remove this last named source of expense and overcome the greatest objection to the use of these coals.

The peculiar affinity of ammonia for H_2S is well known, as also is the extreme solubility of the sulphides of ammonia.

Estimating the average quantity of H_2S in the crude gas at 50 volumes per thousand, the weight of pure sulphur will be more than 40 pounds—a quantity sufficient to produce more than 100 lbs. of sulphuric acid—in the gas from each ton of 2,000 lbs. of coal.

The present cost for lime is nearly three cents per thousand feet. If the cost of operating the ammonia purification should be no greater, the sale of sulphuric acid and of sulphate would have the very satisfactory effect of changing a heavy expense into a handsome profit.

Discussion.

Mr. Egner—I would like to ask Mr. Chollar what is the condition of the lime. Is it very wet?

Mr. Chollar—It is wet, but not so wet as is customary to use it where Pittsburgh and Eastern coals are used, because the Kansas coals have a larger amount of sulphureted hydrogen which generates water in the purifiers.

On motion of Capt. White, the thanks of the Association were voted to Mr. Chollar for his interesting paper.

The President—We will take up one more paper to-night, which will still leave five for to-morrow.

Mr. Jno. Young, of Allegheny, Pa., then read the following paper on

SOME THOUGHTS ON FUEL GAS INDUCED FROM PRACTICAL EXPERIENCE IN THE DISTRIBUTION OF NATURAL GAS.

Mr. President and Gentlemen of the American Gas Light Association: The discovery and application of natural gas for domestic heating, and manufacturing purposes in quite a number of places, and its superiority over coal as a fuel, have stimulated research into the possibility of manufacturing a fuel gas to supply localities not favored with the natural article. Some of our ablest and most advanced gas engineers have taken the matter in hand and have, in these meetings and elsewhere, expressed their faith in the ultimate commercial success of a manufactured fuel gas. That there are at present, however, very great difficulties in the way, will, I think be admitted by the most sanguine. The most formidable difficulty that has to be encountered is in what I may term the commercial difficulty, viz.: The difficulty of producing the gas at a price people will buy it. There are other difficulties which our experience in supply of natural gas has made very evident to us, and it is probable they may have been overlooked to some extent by those having no experience in supplying fuel gas. I refer particularly to the erratic and varying demand and to the great disproportion between the maximum and minimum demand. These may be termed simply mechanical difficulties, but to overcome them will greatly increase the commercial difficulty as it involves excessive outlay on plant. In order to make this matter as clear to you as possible, I shall deal with the whole of our domestic consumption in Allegheny City.

Allegheny City is supposed to contain a population of from 90,000 to 100,000. The number of houses is probably about 15,000. Of that number we supply 7,500. We consider we supply almost every house worth supplying and probably in the cities of the size and character of Pittsburg and Allegheny not more than one half the houses would use fuel gas, even if its cost approached the price of coal. There are various reasons for this which your experience in supplying illuminating gas would suggest. Taking, then, the city of Allegheny, with its 100,000 population, as an illustration of the quantity of fuel gas required for a given population, we can learn something of the capacity of a fuel gas plant required for its supply from our experience in supplying natural gas.

We can arrive at this pretty correctly from the fact that about one-half of our consumers are supplied by meter. There is, therefore, no haphazard estimate as to the quantity of gas required. Last winter was exceptionally mild, and the figures would give the minimum rather than the maximum of winter consumption. The average consumption per house per day from November 1st to April 1st was 2,000 cubic feet, but as at least 75 per cent. of that quantity is used between the hours of 7 A. M. and 10 P. M., it would be necessary to provide for an average consumption of 100 feet per hour for each house, or at the rate of 750,000 feet per hour, making for the 15 hours a total of 11,250,000 cubic feet. Add to this the additional 500 cubic feet required for each house for the balance of the 24 hours, and we get a total of 18,000,000 cubic feet as the quantity necessary to supply 7,500 consumers on an average winter day.

You will notice, however, that for 9 hours out of the 24 the consumption is only 500 feet per hour for each house, equal to a total of 416,666 cubic feet per hour, as against 750,000 for the other 15 hours, the average for the 24 hours being 625,000 ft. per hour.

I need not point out to you that to produce gas economically it is necessary the production should be pretty nearly uniform during the 24 hours. To make 750,000 feet per hour for 15 hours and then drop to 416,666 for the remaining 9 hours would be very awkward and also very costly. It will, therefore, be necessary, in order to get a uniform production, to have a storage capacity of 3,750,000 cubic feet. There is, however, another and more difficult phase of the matter. In providing for the supply of fuel gas to any community it will be necessary to provide manufacturing and distributing plant adequate to supply the greatest consumption. The greatest consumption will, of course, occur on the coldest days. As the temperature rises or falls, so in a regular proportion will the consumption be greater or less. With a given consumption at 32° temperature, it will increase 50 to 60 per cent. if the temperature falls to zero. In our changeable climate, such a fall often occurs within 24 hours. Within that period the consumption may rise from 750,000 feet per hour 1,125,000 feet per hour, requiring 16,875,000 feet in the 15 hours, instead of 11,250,000 cubic feet, an increase of 5,625,000 in 15 hours. You can appreciate the difficulty of being suddenly called upon to increase your production by over 5,500,000 fee. Therefore, to avoid intermittent work and provide against failure of supply, it will be necessary in order to supply even the comparatively small number of 7,500 consumers to have an enormous storage capacity. In the demand for illuminating gas, there is a gradual and steady increase from the minimum to the maximum consumption, and a corresponding steady decrease from the maximum to the minimum. On the contrary, during seven months in the year, the demand for fuel gas is most erratic, sometimes varying from 50 to 60 per cent. in 24 hours, and seldom for a week together will the demand be anything near uniform. In June, July, August and September, the consumption of fuel gas dwindles down to a mere fraction of the winter consumption. The difficulties that have to be met in erecting a fuel gas plant are, first: The necessity of providing a manufacturing and distributing plant equal to the greatest demand (which demand may only exist for two or three weeks in the year), involving great outlay and comparatively small returns. The providing for erratic demand necessitating great storage capacity or else intermittent and expensive working. It may not be uninteresting if I try and give you an idea of the capacity and cost of a fuel gas plant necessary to supply 7,500 consumers. I shall assume the possibility of distilling the volatile matter from a bituminous coal and converting the residual coke into water gas at one operation in the same vessel. I shall assume that the process will produce 30,000 feet per ton of coal of the mixed gases, giving 400 heat units per cubic foot. I shall also assume (which is considerable of an assumption) that by improved appliances for using the gas, one foot of the fuel gas containing 400 heat units per foot can be made to perform the same amount of work that one foot of natural gas is now doing with its 1,000 heat units per foot.

I shall further assume that coal will cost $2.00 per ton and that each stoker (I do not know any better term) will produce 75,000 feet per day. To get at the maximum quantity required, it will be necessary to get the average temperature for the five months on which our figures are based, then allow for the extra quantity required at a zero temperature. The average temperature for the five months was 3,664 degrees, and, as the average daily consumption of gas was 15,000,000, we must add at least 50 per cent. to that quantity, making 22,500,000, the maximum daily quantity that must be provided for. The yearly capacity of a plant providing 22,500,000 feet per day is 8,212,500,000 feet, but as during (we shall say) seven months of the year the average daily consumption is only 15,000,000 cubic feet, and during the other five months only one-fifth of that quantity, the total amount required for the year is only 3,639,000,000, equal to only 44 per cent. of the actual producing capacity of the plant. I am not sufficiently conversant with the cost of fuel gas plants to give a very correct estimate of the cost of a plant capable of producing and distributing 22,500,000 cubic feet per day, but if I place it at $3,000,000 I think I shall rather underestimate than overestimate it. With these data we shall try and show at what figure fuel gas can be produced.

121,300 tons coal, at $2.00	$242,600,	or, 0.06660	cents per M.
48,520 days, one man, $2.00	97,040,	or, 0.02660	" "
Management and office expenses	20,000,	or, 0.00549	" "
Distribution, repairs and maintenance (streets)	26,000,	or, 0.00714	" "
Wear and tear and yard expenses	36,390,	or, 0.01000	" "
8 per cent. on $3,000,000	240,000,	or, 0.06595	" "
		18.178	cents per M.

It will be seen that in providing for the wants of even a comparatively small community, we have to deal with large quantities, and if the use of a fuel gas were to become anything like general in our large cities, the consumption of raw material would be enormous. At this point it is pertinent to inquire what material can be had in sufficient quantity to supply such a large demand, and I think we can reply unhesitatingly, coal, and coal only. It is also safe to make the assertion that the whole of the coal must be converted into the gaseous form. If the volatile portion of the coal alone were used, no sufficient market could be found for the immense amounts of secondary products, such as coke, tar, ammoniacal liquor, etc. While petroleum may be a factor in the production of fuel gas, so far as my knowledge extends, its quantity is too limited to be depended upon as a universal fuel.

You will observe there is nothing included for purification or leakage.

The gas produced from the volatile portion of the coal should contain about the usual percentage of ammonia. If that is extracted, manufactured, and sold, I assume it would pay for the purification. I have taken the cost of coal at $2.00 per ton, as I presume that is about an average price. Of course, any advance or decrease from that price will proportionately affect the cost of the gas. If the above figures are anything near correct, they indicate that a fuel gas containing 400 heat units per foot can be produced and sold at 20 cents per M cubic feet, when the quantity produced is large. The problem to be solved is, can this gas be made to perform the work of heating and cooking in a house at a cost not to exceed 25 per cent. more than the cost of coal. I be-

lieve it must do this in order to become a popular fuel. One ton of coal will develop 27,000,000 heat units. 30,000 cubic feet of gas at 400 heat units per foot will develop 12,000,000 heat units. By perfect combustion, and greater utilization of the developed heat, it may be possible to make 30,000 cubic feet of gas perform the work of a ton of a coal, but even then the 30,000 feet will equal coal at $6.00 per ton.

You will bear in mind that the estimate I have made of the quantity of gas to be produced is based on the supposition that 1,000 feet of fuel gas of 400 heat units per foot will perform the same amount of work we are now doing with natural gas having 1,000 heat units per foot.

Notwithstanding the great progress that has been made during the last fifty years in attaining in practice to theoretical values, it seems as if very little progress has been made in utilizing to anything near its theoretical value the fuel used in private residences. The abundance and cheapness of wood and coal have caused the matter to be left almost untouched, and to-day the appliances for heating our houses, so far as the principles of economy are concerned, are about as unscientific and wasteful as they were a hundred years ago. If fuel gas is to be the fuel of the future, attention must be turned to devising means, first, to secure perfect combustion of the fuel, and then to utilize the developed heat to the utmost extent for heating the inside of our houses, where it is wanted, instead of sending from 80 per cent. to 90 per cent. of the heat up the chimney to heat the atmosphere outside where it is not wanted. In this direction I think lies the solution of the fuel gas problem. The price at which a fuel gas of practical value can be manufactured and sold is pretty well determined, and under no circumstances, so far as I can see, can it be sold cheap enough to displace coal if used in our present appliances. That it is possible to greatly improve on our present methods and attain much nearer the theoretical value of the fuel, admits of very little doubt, but as yet comparatively little has been done in that direction. We still adhere to our various forms of stoves and open fireplaces, hot air furnaces that do not heat the air, unless the products of combustion are going into the chimney red hot, and steam heaters that are even worse in this respect. There is no difficulty in constructing a hot air furnace in which the products of combustion can be reduced to the temperature of the outside atmosphere, if it is desired to do so, thus utilizing the greatest possible amount of heat generated by the fuel. In heating by steam or hot water this of course is not practicable, as the products of combustion must pass into the chimney at a higher temperature than the water or steam, and thus loose a great deal of heat. It might, however, be possible to utilize the waste heat in some way, say by combining the steam heating with a hot air furnace. The rapid progress that has been made during the last few years in reducing the cost of production and distribution of electric lighting, its rapidly growing popularity for street lighting and for stores, hotels, theatres, railway stations, and even private residences, point to a not far distant time when illuminating gas companies must look to some other means of utilizing their manufacturing and distributing plant than in the supply of illuminating gas. Would it not be well for gas companies to spend some time and money in investigating into the possibilities of a manufactured fuel gas when applied to domestic heating and cooking on thoroughly economic and scientific principles. To carry out an investigation of this kind thoroughly will require a thorough knowledge of the laws of combustion, a knowledge of the best methods and appliances for utilizing to the utmost possible extent the heat produced, and a knowledge of sanitary laws that will prevent securing economy at the expense of proper ventilation, and the healthful conditions that should obtain in every house. A good deal of isolated effort has been already made in this direction, but so far as I know, very little of a reliable character is yet known which embraces all the above conditions. To existing gas companies will naturally fall the supplying of a fuel gas, if such a thing is practicable, and surely it is worth while to try and find out with some degree of certainty what can be accomplished in that direction. If the public demand a fuel gas, there is hardly a doubt but the demand will be met, no matter how great the difficulties in the way may be. The importance of pure air in relation to health was never realized to the extent it is to-day. There is a general outery against the filthy, unhealthy, costly and unscientific system of throwing into the atmosphere of our cities thousands of tons of unconsumed carbon in the form of smoke which depresses our spirits, irritates our lungs, saps the energy of our wives and daughters by the incessant and irritating warfare against dirt, and lowers the whole tone of our moral and physical nature. The remedy is gaseous fuel. It may be difficult and somewhat costly, but if it falls within the range of possibility, there is little doubt of its accomplishment.

Discussion.

The President—This is a very interesting paper, indeed, and raises questions worthy of consideration and discussion.

Mr. Denniston—Without having known what Mr. Young was going to say, I am happy to have him corroborate my statement that it would be a difficult matter to manufacture fuel gas for general distribution, or for cities generally. If I accomplish what I aim to accomplish in furnishing a fuel gas for iron and steel furnaces, very much will be accomplished towards the end desired. You will see, by Mr. Young's paper, the immense amount of holder capacity that we must have to supply a producer gas that could be distributed at anything like the figure given. Mr. Harbison says he does not want anything of that kind, but I will be satisfied if I can get such a gas as I claim it would be an advantage to us to try to get, and for the members of this Association theoretically and practically to work for. If you can get enough to run one iron furnace successfully, without a holder even, you have accomplished a great deal. But you will not need such a great holder capacity for such purpose. There will be no more holder capacity required than for the ordinary gas supplied to-day. What do the gentlemen want? Do they prefer to go to individuls? Would they sell lower to manufacturers than they would to a thousand individuals that they might distribute the gas to? You get one mill fully supplied with a good, cheap gas, which will take as much as a thousand individuals, and you have accomplished a feat which will make you a hero, and you will go down with honor to your grave. Now, I ask you, as practical men, whether or not that thing can be done? What I want to say is that I do not believe it can be done on the scale marked out by Mr. Young, for that amount of money; that I do not believe you can get holder capacity enough in this city, with its eight gas works holders, to supply the necessary fuel gas for all the people, for the sum named. I do not believe that three million dollars will do it. Therefore, if you get a fuel gas which will answer for manufacturing purposes, it will be an object attained which I hope yet to see accomplished, and which any gas man would be proud to have realized. Then if you can do that, supply fuel gas for heating bath rooms and for grates, etc., then you can use your illuminating gas as a gas which must come higher than any gas which you can afford to use for fuel. The manufacture and distribution of fuel gas will come latter.

Mr. Harbison—I do not wish to be understood as entertaining the idea that I do not want the fuel gas for manufacturing purposes. I do. But that is not the object that we are after, so much as to supply what was said to be a public demand for a fuel gas. The public demand means a demand from the general public, and not from the select few who may be engaged in any special line of business. What I am anxious for is that it shall not only be a gas that we can furnish to manufacturers, but a gas that we can furnish to the public generally for domestic uses as fuel, instead of their hot air furnaces, and instead of their cooking stoves, in which they use coal; so that they can use the gas fuel instead. Can any system be devised which will accomplish that end? May we not hope that a system will be devised which will enable us to make this gas and furnish it at a price which the people can afford to pay, and which they will pay, and which at the same time will pay a profit to the manufacturers? The statements given by Mr. Young are the most definite of anything that I have yet seen with regard to the cost of doing this work, and the most satisfactory evidence that I have yet heard on this subject. I have heard it claimed it was not necessary to have storage capacity in the use of a manufacturing or fuel gas. I have heard that claimed by parties engaged in the business. I doubted the statement then, and I doubt it still. There is no company furnishing fuel gas that can manufacture a supply in a satisfactory manner unless they have storage capacity. We are always liable to accidents, and to changes in temperature which necessitate extra storage capacity and additional outgoes. The gas cannot be made on impulse, or in a moment. We must have the stock in hand that we have now every day to supply the demand. We cannot make gas now as fast as it is consumed in the hours when it is needed for illumination. We make it during the day and accumulate it for evening burning. We would have to keep a stock of fuel gas on hand in some way, and that would require larger holder capacity. I do not apprehend that any company can afford to go into the business of making fuel gas and put down a plant for that purpose, simply to supply a manufacturing demand, because manufactories are distributed over a large territory, and it would require an immense outlay of mains to reach them; and no price which manufacturers could afford to pay would compensate the gas company for this large outlay. We must have a large demand from the general public, sufficiently large to utilize the mains which we lay to supply the manufacturers. The figures given by Mr. Young would seem to indicate that the fuel gas of which he speaks can be distributed for about 18 cents per thousand feet. There is included in that cost of distribution the necessary outlay for repairs and maintenance. A company that is furnishing fuel gas to-day, as we have recently seen, is selling its gas at 30 and 40 cents per thousand feet, and measuring it by meter; and yet it is admitted by the managers that they have never made a dollar, but that they have lost a great deal of money in their efforts to introduce it, and have not yet been able to pay a single cent on their capital. Other companies manufacturing and selling fuel gas at 50 cents per thousand feet have gone into bankruptcy. One company in New England is to be sold at auction—the entire plant—within a couple of months of this time. Now, if this gas cannot be put at a price which will make the heating value of it equal to coal at $6 per ton, how can we get a price for fuel gas and sell it at a profit?

Mr. Graeff—I would like to ask Mr. Harbison if the company which he refers to as the one not able to make any money is not the company at Jackson, Michigan.

Mr. Harbison—I do not know that I ought to state just what company I refer to.

Mr. Graeff—Then I would like to ask him if it is not a company which has been spending a good deal of money on its plant and in extensions, and whether that company has had a complete plant for a sufficient length of time to demonstrate whether it can make money or not.

Mr. Harbison—That would not change the correctness of my statement.

Mr. Graeff—But it would change the strength of the argument.

Mr. Harbison—No; for the reason that the cost of enlarging the plant ought to be charged to the capital account, and not to the cost of producing gas.

Mr. Graeff—In other words, the company has not yet got upon a basis which will enable it to demonstrate whether it can make money or not.

Mr. Harbison—The company which I allude to has been doing business for two years.

Mr. Graeff—But on a very small basis.

Mr. Harbison—They are making considerable gas now—I do not remember just what amount; at any rate, they have been working it for two years. They claim that they have now got to a point where they

are not losing money, and they hope to increase their business so as to make something, and I hope they will. I hope they will be successful in their operation, and make money, and show us that we can do the same thing.

Mr. Graeff—The company in New England to which Mr. Harbison refers never was anything but an experiment. It was used, by the party who founded it, as a basis for the establishment of a syndicate that did not get established. I do not like to see an instance of that kind quoted, or a bankrupt company quoted, as an argument against the possibility of success.

Mr. Harbison—I do not wish to be understood as arguing against it. I am quite in favor of it. I wish to see it succeed. I am anxious to have some one show me that I can afford to introduce it in the city of of Hartford, and produce gas there for fuel that the people will want and will be ready to pay for, and which I can furnish at a rate that will enable me to make something on the investment. That is what I am anxious for. I am not speaking against it. I am seeking to encourage those who are engaged in it. What I want is to get at the facts in the case. The country has been flooded sufficiently well and long with statements that would not bear the light of day, and it is the facts that we are after. That is the reason why I moved that Mr. Clark be requested to continue in his work, and give us some additional facts a year from this time.

Mr. Graeff—I would like to ask Mr. Young how much holder capacity he thinks would be necessary for fuel gas.

Mr. John Young—I think, in order to be safe, that it would be necessary to increase the day storage.

Mr. Graeff—How much would be necessary in furnishing a million feet of gas per day to a manufacturing establishment?

Mr. John Young—That is a different matter altogether.

Mr. Graeff—Why can there not be some analogy between the two? If a manufacturer can use a million and a-half cubic feet of fuel gas per day, and use a holder of not more than thirty thousand feet capacity, why must there be a full day's capacity of storage for general distribution?

Mr. John Young—There are various reasons for that. The manufacturer starts up his works in the morning, and he runs usually at about the same capactity the whole day; and you have to make about the same quantity of gas every day. I think that is very much the case. Then, if his machine breaks down it is only the manufacturer who loses; but if your machines break down, or anything goes wrong, you inconvenience the whole community. I think that the same rule would apply to fuel gas that applies to illuminating gas. You would have to have your make pretty nearly uniform, or else it would have to be very expensive. Suppose that you had to make fifteen million feet to-day and twenty-two million feet to-morrow: it would be very expensive to get the apparatus and men together to make that extra seven million cubic feet. If you had the storage capacity you could go on working regularly and thus provide against any break-downs of your plant, or any other accident that might arise. It is a very serious matter to put everybody in a town in darkness, and it is a still more serious matter to please everybody in a town. But you can get a candle or an oil lamp to take the place of illuminating gas, whereas if a man has his grates and stoves fitted up for burning gas it is quite different, and a far more difficult matter to get the gas burners out and get coal in the grates and stoves for heating.

Mr. Graeff—Would you not make that gas continuously? Could you not devise a system which would make the gas continuously?

Mr. John Young—Certainly; and that is my idea of making the gas.

Mr. Graeff—Then you would make about a million feet per hour?

Mr. John Young—To make it continuously you must have your demand continuous, or else you must have storage capacity.

Mr. Graeff—If you are going to make gas continuously, and set the limit that your plant shall make at a certain quantity of gas every day, then you must have a steady demand for it; but I do not see why it cannot be regulated upon a large scale just as manufacturers require it. If on one day they want a million feet, and on another day a million and a-half, I do not see why, with a steady capacity of one million feet per hour you must need a storage capacity for twenty million feet.

Mr. John Young—But you do not use a million feet per hour each of the 24 hours.

Mr. Graeff—But you have your generator capacity ready to supply any extra demand, as it increases.

Mr. John Young—You would have the men idle during eight or nine hours a day, and your plant standing idle.

Mr. Graeff—I think that would be better than carrying such large storage capacity.

Mr. John Young—Your storage capacity is only what it costs.

Mr. Graeff—I would like to say one thing more, that, as a fuel gas enthusiast, I feel very much indebted to Mr. Young for presenting the points he has made in such a practical manner. What those who are advocating fuel gas wish to know is, what are the difficulties which lie ahead in their path; and I think that Mr. Young has presented the difficulties which lie ahead of the fuel gas men in a very clear and able manner, and I think that every one should be obliged to him. I would like to suggest that we seem to be getting more into a discussion as to the application of gaseous fuel for manufacturing uses, whereas I think that what this Association needs more particularly to know and understand is the application of gaseous fuel for general uses. The question of manufacturing gaseous fuel for manufacturing uses is settled. Its success is settled. If Mr. Young or any one else will come to Philadelphia I will show him or them where gaseous fuel is doing to-day what gas has never done before in a like establishment; and I will show it to him upon the word of a man whose statements no one will question. The working of gaseous fuel as regards manufacturing establishments is settled. I think that what we want to bend our energies towards is finding out how it can be made to serve best our own private consumers. In that line I think that Mr. Young has done us very good service, and I wish to thank him.

Mr. Robert Young—There is one thing I notice in my brother's paper. He assumes that a gas having 400 heat units per cubic foot might be got to do the same amount of work we are now doing with a gas that has 1,000 heat units. My advice to him would be, if he makes an attempt to heat the average house in Allegheny with 2,000 feet of gas having only 400 heat units to the foot, he had better be in Baltimore or some other distant place. I noticed from observations taken at my meter last winter (which was a very moderate winter in our section of the country), that on some of the coldest days it took 5,000 cubic feet of gas, which had 1,000 heat units per foot, to keep my house comfortable. I am very careful not to let the temperature get above 70°. The halls are kept at 70° by a hot air furnace which I built expressly for using gas. The only place that I see where it is extremely wasteful is the cooking range. I am sure 50 per cent. more gas is used there than is really necessary. I am talking now of our present method of using the gas, but I think a great deal has to be learned how to utilize a greater amount of the heat developed from the gas than we do at present. I don't see how we can assume that a gas having 400 heat units can be made to do the same amount of work that gas having 1,000 heat units can. We are very anxious to get a fuel gas, and I think it is to all our interests to study the fuel gas question.

Mr. Cornell—This is a very interesting subject, and the views which Mr. Young has expressed bring before us very clearly and fully the difficulties in the way of this enterprise in which we are all engaged and which we are looking forward to as promising to be successful in the future, and in a future not very remote. I think these difficulties which appear before us come pretty largely from the fact that we reason from analogy. The analogy of making illuminating gas is the one which brings out a very formidable difficulty, and which Mr. Young presents very clearly to us—and that is the amount of storage capacity required. Yet we must remember that in illuminating gas we make for the whole 24 hours, and desire to make it continuously during 24 hours, that which we only use during five or six hours; whereas for fuel gas we are making it for continuous consumption throughout the 24 hours. That fact greatly modifies this question of storage. I think it is entirely practicable, and with all deference to the experience of Mr. Young as stated to-day, I think there is no proof that it is not entirely practicable to get along without such a large amount of storage, and to make such an amount of gas as would be required to supply the demand. If there were 30 or 40 actual producers, and if 15 or 20 of those were in actual use all the time, and five or ten more were in such a condition that they could be brought into use within a few hours, I think there would be no very great difficulty in providing for the increased consumption—for a suddenly increased consumption—without anything like a day's storage, and with possibly but a few hours' storage. That is one way in which I think that our analogies are apt to bring us into trouble. If we can throw away those analogies of storage as they relate to illuminating gas, I think we can dispose of the difficulties which are presented. Another one which comes up very clearly and directly is the analogy from the use of natural gas. In the use of natural gas, where it is very abundant, and where it has been furnished at very low prices, the whole community have been using it, so that a very large amount was used, and the use was very wasteful, so that it took an enormous amount. But, in using manufactured fuel gas we must conclude that it is to be used not on the basis of coal, but on a very much higher basis; and that it is only those people who can afford to pay, and who will pay a very much higher price for the increased healthfulness and cleanliness of gaseous fuel, that are going to use it at present. Therefore, we may reduce the amount to be supplied. In Allegheny the 7,500 users would have to be reduced to a third of that number, and the price increased to such an amount at least as coal would cost in Allegheny or Pittsburgh, and so remedy in part that difficulty. I think we must look in this direction for a great modification of the difficulties which Mr. Young presents.

Mr. Harbison—I wish to call the special attention of members of the Association to the remarks of the President in his address this morning on this subject of fuel gas, and particularly to that part in which he alluded to what was being done with gas stoves. I want to reply to some statements which have been made in this town within 24 hours, more or less, with regard to the town in which I live when I am at home. We have there in use show 1,600 gas stoves. We are selling more than 20 per cent. of our entire output of gas between seven o'clock in the morning and five o'clock in the afternoon. Notwithstanding the immense inroad which has been made upon us by the introduction of the electric light in past years (it having taken away nearly 1,400 street lamps), during the past four months we have sold much more gas than we did in the corresponding four months of last year. (Applause.) During the month of September (notwithstanding we sold a year ago in September, nearly, 70,000 feet of gas for lamps) our output for the month of September was more than half a million feet above what it was a year ago.

Mr. Robert Young—What are you doing with gas stoves?

Mr. Harbison—We are selling gas in Hartford to-day at $1.25 for certain purposes; and I can show as good things there as Mr. Graeff can in Philadelphia. Come and see them.

Mr. Robert Young—Suppose that you had no gas stoves there, what would be the difference with regard to the amount of gas consumed? Suppose that you took your stoves out altogether, would not the account of your gas used for illuminating purposes be much affected?

Mr. Harbinson—Then we would turn our attention to displacing the electric light—as we are doing now. One store there where they have

been using sixteen incandescent lights, we are going to light with gas before the week is out.

Mr. Robert Young—That is what you ought to do. How much of the business of the gas company has the electric people taken? That is what I would like to know.

Mr. Harbison—In our city one-eighth of the entire output was sold for public lighting, and that is all gone.

Mr. Robert Young—You have no idea how much for private lighting.

Mr. Harbison—No, but although they have taken a very large amount, yet we are now where we were a year ago.

Mr. Robert Young—That is largely owing to the gas stoves, and not to the use of gas for illuminating purposes?

Mr. Harbison—There is a very large increase for illuminating purposes as well as for gas stoves?

Mr. Starr—The increase I imagine is very largely due to the low price of the gas.

The convention adjourned to October 17th, 1889, at 10 A. M.

SECOND DAY—OCTOBER 17—MORNING SESSION.

The Association met at 10:30 A. M.

INTRODUCING MR. CORBETT WOODALL.

The President—We have with us to-day a gentleman well known to most of you as a prominent gas engineer of London, Mr. Corbett Woodall, and with your permission I will invite him to take a seat on the platform. (Applause.)

Mr. Woodall—Gentlemen: I hardly expected that the President would be good enough to introduce me to you in this manner, and I am sorry to confess that I find myself with very little to say to you. I feel my mind very full of sentiments of thankfulness for the very great courtesy and kindness with which I have been received by all my professional brethren on this side of the water; and although I have no authority at present to speak as a representative of the Gas Institute on our side of the water (to my great regret not being a present member of that body) yet I am quite sure that I only interpret the feelings of the great body of English engineers (gas or otherwise) in saying that the recollection of all the kindness that has been shown by you Americans to our countrymen visiting this country, has made them most anxious for an opportunity to reciprocate those many kindnesses on our own side. (Applause.)

I cannot help feeling this morning drawn back to two little episodes in connection with your Society, and with our own people at home, that have been fully in my mind even since I found that I was able to have the pleasure of attending this meeting. One of them was the meeting of our own Society which was attended by certain members of yours, in the year 1878, and when I had the pleasure then to welcome one of the men whom I held then, and shall always hold in very pleasant memory—Major Dresser—together with Mr. Forstall and Mr. Greenough, when they came over to attend the meeting of our Association, of which I had the honor at that time to be President. I assure you that the recollection, especially of our late friend Dresser's aimable, kindly, cheerful, admirable spirits, will take a long, long time to efface from the memory of those who were present on that occasion. I cannot help thinking also this morning of another gas man who, two years ago, stood very much in the same position in which I have the honor to stand to-day before you—my old friend Mr. Spice. I am sure that those of you who met him must share the regrets that we felt on our side when he was so suddenly taken away from our midst. I know that you have a busy day before you, and that I am simply wasting your time by attempting to make a speech to you; but I must ask permission to say how struck I have been with the differences in the character of the work that you are called to do in comparison with that which occupies us at home at the present time. The variety of the questions and problems that you have before you is something almost bewildering to one who for a comparatively long period has gone along the steady course of simple coal gas making. One of the things that made me particularly glad to come to this meeting to-day is the opportunity presented for studying the question of the distribution of fuel gas. I find many of you very largely engaged in the manufacture and distribution of water gas, and I find many of you not simply making and distributing gas, but also carrying on the business of electric light engineers and suppliers. The whole thing is so much fuller—I will not say more complicated—but giving so much wider scope for individual effort, thought and enterprise, that it has added very much indeed to the pleasure I have in visiting your works. In the manufacture and distribution of coal gas I think that we are able still to hold our own pretty decidedly in comparison with American works; but in all these other respects we have a very great deal to learn. I can only say in conclusion that I am extremely grateful for the readiness which I find on your part to communicate the many interesting things which you have to say. (Applause).

OTHER INTRODUCTIONS.

Mr. Harbison—I understand that President-elect McMillin is in the room, and I move that a committee be appointed to escort him to the platform.

The President—I will appoint Mr. Harbison to be that committee.

(Mr. Harbison escorted Mr. McMillin to the platform.)

The President—Mr. McMillin, it gives me very great pleasure to know that when I vacate this Chair it will be occupied by a gentleman of such well known ability as yourself. (Applause.)

Mr. McMillin (President-elect)—I would much rather listen to your applause than to my own voice. Never having appeared before a gas convention before it is a little bit embarrassing. Having been forbidden by my physician to attend the convention at all you will excuse me, I know, for not attempting to make a speech upon this occasion. I obeyed the mandate of my physician until I got the despatch last night notifying me that I had been elected President of the Association. Then I could not stand it any longer, but came over to bow my acknowledgments; and that is all that I can do this morning. I want to add my congratulations upon the very large attendance. I am delighted to see so many here, and I trust that the attendance may be quite as large next year. (Applause).

The President—I notice that we also have with us to-day General Louis Wagner, Director of the Department of Public Works of the City of Philadelphia. He has a still higher title—that of gas man. I invite him to the platform. (Applause).

Mr. Wagner—You will pardon me if I speak from the floor; I am not entitled to the honor of an invitation to the platform. Unlike the President-elect, who has never appeared before a gas convention before, and now disobeys his physician by coming here, I was told by my doctor that I was sick and ought to go away from home a day or two for the purpose of recovering lost health and strength; and where could I better do that than in a gas convention. Of course in what I may say, I do not speak from experience except in so far as I have gained experience in reading the proceedings of this eminent body, and of eminent bodies like this. I trust, as the President-elect does, that the attendance next year, and for years to come, will continue large, and that the exercises will be as profitable at this convention, and also at succeeding conventions, as they have been in years gone by. If they shall cease so to be I do not know what will become of the gas business in this country. And of course, in England, as we have learned of our friends from abroad, their movements are influenced and directed to a very great extent by what they hear and learn from America. So far as the gas business in Philadelphia is concerned, I may say that we have there a great deal of various kinds of gas. A little girl of mine once had given her, as the subject for an essay. "Milk," and she wrote, "there are many kinds of milk; and so I say that there are many kinds of gas in Philadelphia. Of course, you don't have the same variety that we have in our city. Of coure we have illuminating gas, as you have everywhere. We used to have a gas in Philadelphia that did not illuminate very much; but now it does vey nicely. But we labor under particular and peculiar disadvantages, or have been doing so until the last year. My friend Park, who has been Chief Engineer of the Philadelphia gas works for many years, has, I have no doubt, told you all about it. He was handicapped in his business for the last few years because he had twelve men to manage him—twelve bosses in the gas business, I mean—each of whom knew more about it than he did, and each one of whom wanted to run the gas works in his own peculiar way. When that condition of affairs was changed, and one man was set to direct not only the gas business, but the public works generally, who did not know anything about gas, then, of course, Mr. Park could do just as he pleased, and the reports, of which he has sent you copies during the last three years, show you that he has been pleased to do right well; and all that we have accomplished in Philadeldhia is due entirely to his efforts. Of course, when I get back from this convention, having learned all that there is worth knowing about making gas (as I shall at the close of the session to-day), I shall set up as a boss and tell him how to make gas. I sincerely hope that nobody will try to lead me astray in the gas business, because if I should learn anything wrong there will be lots of trouble as the result when I get back to the city. I am glad to be here. I want you to believe that, although everybody says it. I hope no doubt, if we all had our deserts, that some of us would be in heaven, and others of us would be in a locality where they do not need gas for illuminating purposes. But I am glad to be here. I am sure that I shall be benefited by being here, and that I shall learn much that is worth carrying back to Philadelphia. Of course everything that is said here is gospel truth, and everything we learn here is of the very best, and so I will take it all back to Philadelphia and apply it all there to the best of my capacity.

The President—We also have with us this morning Mr. Williams, of the United States Census Bureau, who would like to say a few words to you with regard to collecting the statistics of our industry for the next Census Report.

Mr. Williams—I am here as the representative of the United States Census Bureau, for the purpose of laying before you the facts necessary to secure the co-operation of all who are interested in the manufacture of gas, to enable us to present such a report in the next census as we hope and believe will be complete, valuable and interesting to those engaged in this industry. Owing to the death of Major Dresser, who was selected to collect statistics of the gas industry for the census report of 1880, we were unable to present any statement whatever in that report. But it is the desire of the present Superintendent of the Census to have a complete exhibit made for the gas industry, as well as for all other industries; and it will rest entirely with the gentlemen interested in that industry to determine how full and accurate that report shall be. We desire to select some gentlemen to be entrusted with the investigations of that subject, who has the confidence of all who are engaged in gas manfacturing. Just who shall be selected for that purpose will depend very largely upon the wishes of this Association, and of those engaged in the manufacture of gas. I bespeak for him the same co-operation that we have the promise of in other lines of manufacture throughout the entire country. I have visited various cities of the country, and the manufacturers uniformly promise co-operation with the different persons selected to conduct the investigations. I want to say, in conclusion, that I hope the members of this Association will think seriously of the matter, for of course we are all interested in making for the gas industry the best possible report that can be made.

TO BE CONTINUED.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE attention of contractors is called to the advertisement inserted in this issue at the instance of the President of the village of Far Rockaway, L. I. While the advertisement is not so clearly expressive of the intent of the parties in interest as one might wish, nevertheless the evident desire of the village is that a gas works shall be constructed there in order that the public lighting shall be performed by gas. In any event, we are of the opinion that Far Rockaway presents an available opening for the safe investment of capital in the direction indicated, provided the franchise arrangements are on a fairly liberal scale.

AT the Baltimore convention, during the deliberations of the Council of the Association, the matter of indorsing a representative of the gas interest on the committee for New York, in respect to the latter's canvass for the International Exposition of 1892, was discussed. The Secretary was finally instructed to communicate with Mayor Grant, and to urge upon the latter the propriety of naming as such representative Mr. R. A. C. Smith, of this city. As we understand it, the reply made by the Mayor to the suggestion of the Council was about like this, that Mr. Smith had been appointed to the position several months ago. The Mayor is evidently partial to good-looking men.

NEW HAVEN (Conn.) has just finished the construction of a new almshouse, which, of course, is nothing other than might be expected from a corporation that tries to comfort the sorrows of its poor; but what does astonish us in connection with the building is that the gas fixtures installed in it cost $1,305.61.

WE understand that the Jeter-Boardman Gas and Water Association will remove its offices from Macon, Ga., to this city. We hope the rumor is true, for what Macon thus loses will be gain to New York.

ON the 1st of October the proprietors of the Brookline (Mass.) Gas Light Company authorized a reduction in the sales schedule to $1.90 per 1,000 cubic feet net. Keep it up.

IN all probability Mr. N. D. Atwood will accept the position of Treasurer to the Stoughton (Mass.) Gas Light Company.

AS a sequel to the election of the new Board of Trustees of the Wheeling, W. Va., municipal gas works, the following complete change was made in the executive management: President, Harrison Dunlevy; Secretary, A. A. Franzheim; Assistant Secretary, George Heil; Superintendent, S. M. Darrah; Collector, J. B. Wilkie. It may be a good policy that permits of such sudden and radical changes, but we cannot help holding that better results would be gained did merit solely determine the length of time of the tenure of office. We do not wish to imply that M. Darrah will prove to be an incompetent man for the place to which he has been chosen—in fact, we know him to be competent—but it is also indisputable that Mr. Dillon, whom he replaced, has proven his ability for the position. Politics, however, cares little for such distinctions, and knowing this, we submit that municipal gas works can never meet with complete success.

A CORRESPONDENT writes, under date of October 16: "The Birmingham (Ala.) gas works were sold at public sale on the 15th inst. by judgment creditors, under a decree from the Chancery Court. The judgment for which the decree was issued was for the purpose of satisfying a floating debt of $145,700, and the sale, of course, was subject to the bonded indebtedness of $340,700, and $20,000 of accrued interest. The property was bid in by Col. J. F. B. Jackson, for the amount of the floating debt. The Colonel was acting in behalf of a new and strong organization, which is to be known as the Birmingham Gas and Electric Power Company, with a capital of $500,000. It is the intention of the purchasers to put the plant in good shape. The purchase money has, it is said, been all paid, and all creditors will get their money on submission of the requisite proof of their claims. The old bonds are to be retired by a new issue, the financial arrangements for which have been completed.—R. T."

THE Reno (Nevada) Gas Company has been purchased by Messrs. Foley and Powning, who are now in possession of the plant.

THE Trustees of the consolidated gas interests of Troy, N. Y., have selected the following officers: President, Edward Murphy, Jr.; Vice-President, W. Kemp; Secretary, Chas. E. Davenport; Treasurer, D. Lane; Superintendent, H. C. Shields. The office will be located in the office of the old Troy Company, and no change will be made for the present in the manufacturing systems hitherto pursued.

IN the reorganization of the Meridian (Miss.) Gas Light Company the following result was reached: Directors, J. S. Solomon, W. E. Baskin, Jos. Baum, S. E. James and Julius Balke, Jr.; President, J. S. Solomon; Vice President, W. E. Baskin; General Manager, Secretary and Treasurer, J. L. Dime. Considerable improvement will be made on the plant.

THE New Bedford, (Mass.) Gas Light Company is now paying a dividend of $2 per share.

THE authorities of Columbia, S. C., are said to have agreed on a scheme for the public lighting of the place by means of incandescent electric lamps.

THE Chicago *Mail* reports the following concerning certain nefarious practices in respect to the management of the Treacey Carbon Lamp Company: "A bill has been filed in the Superior Court to close up the affairs of the Treacey Carbon Lamp Company. The Company is said to be a tremendous swindle, and James A. Treacey, its President, is said to be a second Keeley. The Company was incorporated, with him as the principal incorporator, for the purpose of making a certain light from a peculiar kind of gas. There was said to be millions in the scheme, and Treacey, as it is alleged, disposed of shares of stock to poor Germans and Bohemians, at the rate of $20 a share, he representing that each share was in reality worth $100, and would soon bring $500. He refused to give any explanation of his wonderful process for manufacturing the materials, but exhibited alleged samples put up in bottles. These samples, it is now asserted, were purchased by Treacey at drug stores. His factory is located in an out-of-the-way place near Cragin or Hermosa. The bill applied for an injunction restraining Treacey from further interference with the concerns of the Company, and also asked for a receiver. Judge Jamieson granted both requests."

AT a recent meeting of the Montreal (Canada) Councilmanic Committee on Light a communication from the Montreal Gas Company, acknowledging the receipt of the resolution of Council ordering 700 public gas lamps, at $16 per annum each, and stating that the price was too low, and would also be unfair to the Company, was read. While this offer on the part of the city could not be accepted, the Company, to show a spirit of accommodation, agreed to maintain the lamps for $17 per annum each, which was the lowest possible price that it would name. The Committee finally agreed to make a favorable report on the Company's proposition.

THE Spanish-American Light and Power Company, of Havana, Cuba, seems to be pretty well satisfied with its operation of an electrical annex, since an order has been recently placed by its proprietors with the Westinghouse Company for apparatus calculated to maintain 3,000 additional 16-candle power incandescent lights, and 200 arcs. The capacity of the plant now in operation is equal to the supply of 1,500 incandescent lamps of 16 candle power, and 100 full power arcs. The average price received for each incandescent lamp is $2 per month—from dark to midnight being the lighting schedule followed. In the meantime, however, it is to be noted as a fact that the increase in the output of the gas department of the Company's business is not less than 10 per cent. Evidently the inhabitants of the ever-faithful isle are anxious for more light.

THE Monson (Mass.) Gas and Electric Company has been incorporated by Messrs. George H. Newton (President) and Thomas F. Robinson (Treasurer). It is capitalized in $20,000. This place, which is noted for its granite quarries, is a post-village of a similarly-named township of Hampden county, Mass. It is on the New London Northern Railroad, at a point 15 miles east of Springfield. Population, about 5,200.

IT has been freely asserted of late that the native oil supply of California had reached its maximum in that State as far back as 1883, and it does not admit of doubt that these assertions are true; for all the productive wells of the State are now at least six years old. The new drill-holes are barren, and the flowing wells are gradually diminishing their output. In fact, so pronounced has been the restriction that the proprietors of the Pacific Gas Improvement Company, which Company supplies perhaps 33⅓ per cent. of the gas sold in San Francisco, have determined to largely increase the number of their coal benches instead of making an equivalent increase to their water gas system. This practice is to our mind proof conclusive that fairly-cheap oil for San Francisco

is a thing of the past; for certainly Mr. Eichbaum would rather direct an increase to the water gas system than to the coal apparatus could his personal preferences be alone consulted.

MR. P. T. BURTIS, formerly Superintendent of the old Chicago Gas Light and Coke Company, has been sojourning in Phœnix, Arizona, for something like a year. He went there for the purpose of benefiting his health, and we are glad to say that his search was not in vain.

A CORRESPONDENT, writing from Washington, D. C., under date of the 15th inst., says: "A day or so ago, in the local Police Court, Prosecutor Armes called attention to a charge of violating a section of the District statutes, relating to the use of gas meters, against a plumber named George F. Schaffer. Mr. C. A. Elliot appeared in the interest of the Gas Company, and explained that Mr. Schaffer was charged with making a gas connection near the gas meter, by which the passage of the gas through the meter for purposes of registration was avoided. This, he said, was the first case brought under the law during the past five years. Mr. A. B. Williams, for the defendant, stated that no denial would be made of the facts charged, but urged that the connection was only a temporary one, and was made the day it was discovered by the Company's Inspector. He, therefore, would offer a plea of guilty, and hoped that a simple fine would be imposed. Judge Miller said that in imposing the penalty he did not want it understood as a license for the illegal consumption of gas, but as a preventive. He then imposed a fine of $25 with 10 days imprisonment, but the latter provision was suspended.—FACT."

THE complaint of Vincent L. Elbert, of San Francisco, Cal., against the St. Paul (Minn.) Gas Light Company has been filed in the office of the Clerk of the United States Circuit Court. Complainant substantially asserts that he is the inventor of certain gas apparatus, for which invention he holds letters patent, and that the defendant is using fixtures and machinery the principles of which are covered by complainant's letters patent. An injunction restraining further use of these fixtures, damages for past use, and a writ of *subpœna ad respondem* to discover the number of said fixtures in use by defendant, are asked for.

THE plant of the Fishkill and Matteawan (N.Y.) Gas Light Company has been leased by Mr. Robt. F. Mullins, whose offices are at No. 10 Wall street, this city.

AT the annual meeting of the Edison Electric Light Company, of this city, held on the 22d inst., Henry Villard was elected a Director in place of A. J. Thomas, Samuel Insull succeeding F. R. Upton. The Board in full comprises Messrs. Thomas C. Buck, C. H. Coster, Noah Davis, Jno. W. Doane, Thomas A. Edison, J. H. Herrick, E. H. Johnson, Morris H. Smith, F. S. Smithers, Henry Villard, Spencer Trask, Samuel Insull and J. Hood Wright. Although these gentlemen are supposed to preside over the destinies of what always has been known as the "Parent Company," it in turn is nevertheless controlled by the "Edison General Company." Mr. Villard is President of the latter concern.

THE Gas Light Company of Galena, Ills., is now in charge of the following executive management: Directors, R. Barrett, L. A. Rowley and H. S. Raymond; President, R. Barrett; Vice-President, H. S. Raymond; Treasurer, L. A. Rowley; Secretary and Superintendent, W. E. French. From this it will be seen that the only remaining representative of the Bixby regime is Mr. H. S. Raymond, who formerly occupied the position of Secretary.

MESSRS. JACOB HIRSCH, Isaac T. Dyer and L. C. Hommes have incorporated the Hirsch Incandescent Light Company. The proposed business is the manufacture of incandescent gas burners under the Hirsch patents. The Company is capitalized in $300,000, and the headquarters are to be in Chicago.

AT a special meeting of the stockholders of the Mutual Gas Light Company, of Southbridge, Mass., a resolution was passed increasing the capital stock to $50,000, the proceeds to be applied to the purchase of the plant, franchises and real estate of the Southbridge Electric Light Company. The proprietors of the latter had agreed to make the transfer two weeks ago, and the plan of combination is now before the State Commissioners. Those in interest in the Gas Company will have control of the combined enterprise.

BILLS of sale—one from the Council Bluffs (Iowa) Electric Light and Power Company and another from the Council Bluffs Gas Light Company, both instruments being conveyances of the stated properties to the Council Bluffs Gas and Electric Light Company—have been filed. This means that hereafter there will be no conflict over the artificial light supply of the city named, and, further, that the field will remain in the control of those who directed the policy of the old Council Bluffs Gas Light Company.

THE officers chosen at the annual meeting of the Fall River (Mass.) Gas Company are: Directors, John S. Brayton, Samuel T. Bodine, Randal Morgan, David Paton, Elihu Andrews, and Henry Levis; Secretary, Geo. P. Brown; Treasurer, Edward C. Lee.

THE Rochester (N. Y.) Gas Company's distribution system is to be improved by the substitution, through Fulton avenue, northward from Lorimer street, of an 8-inch main for the present 3-inch conduit. This move will put an end to the complaints of a lack of gas that were made last winter in the district noted.

WE have it on good authority that Mr. Henry Fitch, of Louisville, acting in conjunction with Mr. L. Biddle, a Chicago manufacturer of electric lighting plants, has secured control in the Jeffersonville (Ind.) Gas Company. This ought to prove a profitable venture, although we presume that a fairly good sum of money will have to be expended in putting the plant in proper condition. The money, however, would be well invested.

MR. J. SMART, President of the Port Hope (Ontario) Gas Company, has forwarded to us the following communication, which explains itself:

"*To* H. W. SANDERS, *Town Clerk*—Sir: The Gas Company having been informed that the corporation have permitted the Electric Light Company to amend their tender for street lighting, beg to be allowed to withdraw their tender No. 1, and substitute the inclosed therefor. We trust that the extremely low price of their present tender will secure to them the whole, or at least a large portion, of the town street lighting."

The amended offer is as follows: "The Gas Company will light, clean, and keep in repair 50 or more gas lamps, on their present or future pipage, through a governor burner consuming 4 feet of gas per hour, the quality of the gas to be fully up to the candle power required by statute, and subject to government inspection, to be lighted and extinguished as per American moonlight schedule of about 1,500 hours per annum, for $15 each lamp per year, payable quarterly; lamps lighted for police service all night to be charged for at $11 each extra, the latter to be put out by the corporation night-watchman on moonlight schedule time. Lamps unlighted to be deducted for in like proportion. The present location of the lamps to be changed, and all present refitting to be done at the cost of the Gas Company, but any after changes made by order of the corporation to be at their expense. All posts and lamps to be furnished by the corporation. As the Gas Company will be put to a large outlay in refitting the service, they are compelled to ask that the contract shall be for five years."

The communication was referred to the Committee on Fire, Water and Gas, and it strikes us that the prices named therein are very reasonable.

"OBSERVER" sends the following clipping (dated 17th inst.) from the Boston *Herald*: "The following obscure paragraph appeared in an evening paper yesterday: 'It is understood that the entire plant of the Brush Electric Company has been sold to the Thomson-Houston Electric Company on a cash basis, the consideration being about $3,250,000.' To those not familiar with the electric lighting concerns of this city it appeared that a tremendous conveyance of a valuable property had been made. To others who did not know anything about the Boston companies the information was startling and mysterious, as there could be no plant of that value owned anywhere hereabouts by the Brush Company. After sifting the rumor out it transpired that about two weeks ago a movement was set on foot by the Boston and Thomson-Houston Companies to purchase the only remaining plant of any importance in the country owned by the Brush Electric Lighting Company, and that was located at Cleveland, Ohio. A week ago the sale of the plant to the Boston combination was made for the amount stated, $3,250,000. The Boston Electric Lighting Company, of which Mr. Frederick A. Gilbert, of Brookline, is President, Hon. Hugh O'Brien, Vice-President, and S. S. Sias, of Cambridge, Treasurer, and the Thomson-Houston system are combined in one corporation, with only a difference of systems, the Boston Company using the Brush system for its arc lights. This Boston combination is fast absorbing the Brush system throughout the United States, and the last purchase was the most important that it has made in some time."

THE "chronic grumblers" out in Kansas City, Mo., have again directed their mouthings at the Gas Company, basing their growls this time on the assertion that the Company was not fulfilling its contract with the city to keep the streets properly lighted. President Payne, when appealed to for the facts in the case, said: "If there are any lamps which the Gas Company should keep lighted and does not I would like to know it. We furnish the city with gas light for a consideration, and endeavor to conform to our contract both in letter and spirit. The Police Department is specially charged to keep a note of every lamp that fails to give light, and at the end of each month the Chief of Police so reports to the Mayor. The Company does not ask for or receive any pay for lamps not lighted. I am always glad for people to complain when we do not give them good service, so that the defect may be remedied without delay. There are people, however, who fail to pay their bills and their gas is shut off. These people are generally loudest in their complaints against the Company, therefore the general public should pay no attention to them."

AT a regular meeting of the Conshohocken (Pa.) Gas Company, the following Board of Directors was chosen: Jonathan R. Jones, Richard H. Bate, Henry M. Tracy, Frederick Light and W. H. Cresson. It was determined to increase the main service by the addition of 350 yards of 4-inch pipe, and also to make provision for new purifying boxes. Another important move made was to name a committee charged with the task of bringing about a consolidation with the local electric light company, which, it is well understood, can be accomplished without any protracted negotiations, and about at the Gas Company's terms.

THE reorganization of the Amherst (Mass.) Gas and Electric Light Company has been perfected in the following manner: President, Henry F. Hills; Clerk and Treasurer, George Cutter; Directors, H. F. Hills, D. W. Palmer, E. D. Bangs, Parnell Munson, F. E. Whitman, E. D. Marsh and P. Alexander. It has been determined to locate the Company's new electric generating station on a plot between the main lines of the New London Northern and the Massachusetts Central railroads, close to where the spur connecting the two roads is to be put down.

SOME talk is heard of a project for the construction of a new gas plant at Willimantic, Conn., but we imagine it would not be an easy matter to enlist capital in such a venture.

THE change from lime to oxide of iron as a purifying agent on the works of the Keene, N. H., Gas Company has been attended with very satisfactory results.

WE are requested to state that there is no truth whatever in the report that Mr. Thomas Humphrey, until recently Superintendent of the Dansville, N.Y., gas works, was or is in any manner improperly indebted to the proprietors thereof.

AT a meeting of the Committee on Gas and Electric Lights, of the Chicago Council, it was decided to allow the petition of the Hyde Park Gas Company to lay a main from Hyde Park to the corner of 46th street and Stewart avenue, at which point it proposes to locate its works.

SUPT. MCGINLEY, of the Philadelphia (natural) Gas Company, says that when the new 36-inch line of main, from Telford to Niblock—a distance of about 2½ miles—is completed, Pittsburgh will have no reason to complain of a shortage in her natural gas supply. He thinks the line will be completed by November 5th.

WASHINGTON (D. C.) gas shares are strong at 211, which effectually disposes of the rumor that certain capitalists would at the next session of Congress make a desperate effort to secure a charter.

THE managers of the Pottstown (Pa.) Gas and Water Company have purchased 12 acres of land (on the high bluff west of the city), on which they propose to erect a large reservoir and pumping station.

DR. J. J. JOHNSTON and his process of manufacturing fuel gas still attract attention, although we are afraid that his system in the Boston trials thereof did not make a favorable showing.

AS a result of the concession made by the corporation of Birmingham, England, in the matter of granting shorter hours of labor to the gas stokers, together with the increase in wages also allowed, it is estimated that the expenditure on gas works account will be increased in the sum of $65,000 per year.

WE understand that articles incorporating the Fort Worth (Tex.) Light and Power Company have been filed. The concern, which is to live for 50 years, and is capitalized in $300,000, is formed for the purpose of distributing gas for light and heat.

Electric Ignition of Benzine Vapor.

Herr C. Groschke, of Vienna, writes:

"On July 7, last, there occurred in my steam and chemical scouring establishment a sudden fire from self-developed ignition, which in a few moments filled with flame the whole department, whose atmosphere was saturated with benzine vapor. The ignition occurred in the following manner. A workman was washing in a tinned copper vessel filled with benzine a white woolen garment richly embroidered with gold thread. During the washing a crackling noise was noticed, and on repeated rinsing of the robe in benzine, sparks were developed which instantly ignited the benzine vapor in the air and the benzine in the copper vessel."

Assecuranz, Vienna, publishing this, says it has made some researches on this point and, *inter alia*, found that at a large scouring establishment in Berlin, Feb. 20, 1882, and January 23, 1883, the benzine in scouring vessels became ignited, in each case while cleansing white woolen clothes. It is well known that benzine vapor mixed with air is easily ignited explosively by the electric spark, and that dry silk and dry wool become electrified by friction. The possibility, therefore, of electric ignition in these cases must be conceded. It can best be avoided if the room where such scouring is performed be saturated with steam.

It seems certain that in the case first mentioned electricity betrayed its presence by the crackling which was heard. A fire happening in Berlin, Jan. 9, this year, resembled those named in a remarkable manner. There was in process of cleansing a lady's shawl knit of wool and silk, and embroidered with gold threads. Fire developed in this piece while in the hands of the workman who was lifting it from the benzine bath. Fire Inspector Bruhns, of Berlin, remarked respecting this case: "It would seem to be not improbable that this article of clothing while isolated by the silk, when the woolen and gold threads were rubbed together, developed electric sparks and ignited the benzine vapor."

"From what has been here shown," continues *Assecuranz*, "it seems plain that the fire described by Herr C. G. was not from self-development of benzine fire, but was caused by an electric spark igniting the benzine vapor. The proposal, therefore, to avoid such fires by charging the atmosphere of the scouring room heavily with steam, is well worthy of attention."

The above seems to confirm an incident of benzine ignition thought to be by frictional electricity, as recorded in this *Review*, Vol. 41, p. 162; also a case of benzine ignition while scouring, in a Philadelphia scouring works, as discussed in the *Review*, Vol. 42, p. 184. In connection with this it is pertinent to repeat that neither petroleum nor any of its products is spontaneously ignitible, therefore there could have been no "self-development" [*Selbstentwickelung*] of benzine flame.—*Am. Ex. and Review.*

Underground Temperature.

In connection with the remarks made by Mr. E. C. Jones, in the discussion which followed his paper on "Leakage and Condensation," at the late meeting of the American Gas Light Association, the following on "Underground Temperature" (from the proceedings of the last meeting of the British Association), will have interest.

In the eighteenth report of the Committee on the Rate of Increase of Underground Temperature, the discussion is chiefly confined to the important observations which Mr. Dunker, who conducted the operations at the well-known Sperenberg bore in 1876, has now, together with Messrs. Kobrich and Huyssen, taken at the boring at Schladebach, near Duerrenberg, which descends to a depth of over a mile (5,830 feet). A full report of this series of observations, undoubtedly the most valuable contribution of this kind ever made, has appeared in the *Neue Jahrbuch fuer Mineralogie*, 1889. The borehole passes through red sandstone, magnesian limestone (Zechstein), lower Permian (Rothliegendes), and coal measures to the upper Devonian beds. It was tubed to the depth of 1,240 meters, the diameters of the tubing being, for the first 584 meters, 120 millimeters; for the next 104 meters, 92 millimeters; then

for 393 meters, 72 millimeters; and for the next 159 meters, 50 millimeters. From this point to the bottom the diameter gradually diminishes to about 1 in. The diamond borer was the instrument employed in sinking this well, which cost about £10,000. The boring rods weighed 20 tons, and required ten hours for hauling up. At Sperenberg india-rubber bags had been used to prevent convection currents, which would affect the temperature indications. Such bags were unsuitable here for for such a narrow bore, and hence plugging of moist clay was employed constructed as follows:

On a cylindrical iron rod, or of tough wood, are two wooden discs of a size just able to move in the bore; the lower disc is fixed, the upper movable, the part of the rod between the two being of the length of the water column which it is desired to isolate. The maximum thermometer has its bulb fastened half way down, either beside or within the rod. The movable disc is removed to a measured distance and the space between the discs filled with clay made plastic by kneading with water. When the pole presses upon the bottom of the bore part of the weight of the boring rods is supported on the upper disc, thus squeezing the clay against the sides of the bore and forming a water-tight plug. When it is desired to isolate a column of water at a considerable distance from the bottom, the apparatus employed consists of two portions; the above description applies to the upper portion, the lower portion is similar but inverted, and the two masses of clay cut off the water column between them. Experiments made with a model showed that the isolation was very good and remained so after an immersion of more than 10 hours. Overflow thermometers were used, generally without scales, the whole, for protectien, being enclosed in a hermetically sealed case of stout glass with an external diameter of 15 millimeters. After being drawn up the thermometer, together with a normal thermometer, was put into a vessel of water at a temperature a little below that which was expected; warm water was then gradually added and the liquid kept stirred until the mercury in the overflow thermometer reached the open end. Further control observations were taken with thick mud introduced and kept between two wooden plugs. The observations extend by regular stages of 30 meters (100 ft.) down to a depth of 5,630 ft. On plotting the temperatures as functions of depth the curve approximates very closely to a straight line. The evidence does not decide the question whether the curve on the whole bends upwards or downwards—that is, whether the rate of increase in temperature is accelerated or retarded with increasing depths. The whole difference amounts to 82° F. in 5,512 feet, which is at the rate of 1° F. in 67.1 feet; by applying the method of least squares, Mr. Dunker arrives at a rate of increase of 1° F. for 65 ft. The Committee have been anxious to interest Mr. G. Westinghouse, Jr., for such work for which the oil and gas wells in the oil district near Pittsburgh would seem to offer a good opportunity. Mr. Westinghouse has readily assented, and has entrusted three of the Committee's maximum thermometers to Mr. Cummins; but for some time to come no proper work can be done. Six observations have been taken at the Dilworth well at depths between 3,600 feet and 4,295 feet, but not with sufficient precautions.

The San Diego (Cal.) Gas and Electric Light Company.

The following brief mention of the above named plants is taken from the September issue of the *Golden Era*, of San Diego:

The publishers of the *Golden Era* take pleasure in presenting to its readers a short sketch of one of the most prominent financial and manufacturing establishments of the city. The present plant of the San Diego Gas and Electric Light Company is the most complete of its kind on the Pacific Coast. There are many larger plants, but few equal it in solidity and permanence of construction, in its possession of all the modern features and appliances for producing both gas and electric light economically, and in its complete adaptation to the purposes for which it was intended. The works occupy the block of land bounded by 9th and 10th and M and N streets, the gas works being situated on the corner of 9th and N, and the gasholder on the corner of 10th and N. The electric light works are located on the corner of 10th and M streets.

The buildings in which the process of gas making is conducted have a frontage of 200 feet on 9th street, are of brick and iron, thoroughly and substantially built, and consist of a coal gas works and a water gas plant.

The coal gas works are what is termed a 10-inch plant, all connections being 10 inch, except the outlet which is 12 inches, and consists of five benches of retorts (sixes); Weber regenerative furnaces, exhauster, tower scrubber and condenser, four purifiers 10x12 each, station meter of 300,000 cubic feet capacity, automatic street governor, and gasholder 150,000 cubic feet capacity. The estimated capacity of the coal gas plant is 250,000 cubic feet daily.

The water gas plant is in a separate building and consists of a generator, scrubber and condenser, known as the "Springer" process, with boiler and engine to operate the same. The capacity of the water gas plant is 150,000 feet daily, making a total capacity of the works 400,000 cubic feet.

The Company has in use 12 miles of street mains, and about 600 meter connections.

The electric light works have a frontage of 100 feet on 10th street, and 85 feet on M street. The power consists of one 250-horse power Corliss engine, and one 60-horse power Buckeye high-speed engine.

The Company has on hand seven 30-light dynamos of the Indianapolis Jenny system, one 30-light dynamo of the Western electric system, and one 65-light machine of the Brush system for arc lighting, and one 100-light incandescent dynamo. The Brush system is used for inside lighting, while the Jenny system is used mainly for outside lighting. The Company has in use about 25 miles of poles and wire, and lights the city by means of ten towers, having six 2,000-candle power lamps on each tower. The towers are especially noticeable, being much more graceful in appearance than the wooden masts and square structures used in other cities. Owing to the excellent arrangement of the towers the city is well lighted, and visitors invariably speak in the highest terms of the system of public lighting and the excellent manner in which it is conducted.

Cement for Securing Iron into Stone.

A new cement, for securing iron into stone, is described in some of the foreign papers. The cement is made by melting resin and stirring in brick dust, which must be finely ground and sifted, until a sort of putty is formed, which, however, runs easily while hot. In using, the iron is set into the hole in the stone prepared to receive it, and the melted putty poured in, until the space is filled; then, if desired, bits of brick, previously warmed, may be pushed into the mass, and a little of the cement thereby saved. As soon as the whole is cool the iron will be firmly held to the stone, and the cement is quite durable and uninjured by the weather, while, unlike lead and sulphur, it has no injurious effect on the iron.

Recent Patent Issues.

The following list of recent patents relating to the gas interests is specially reported by Franklin H. Hough, solicitor of American and foreign patents, 925 F street, N. W., Washington, D. C.

ISSUE OF OCTOBER 1, 1889.

411,809. Gas Enricher. E. W. Hamlin, Wilmington, Ohio.
411,850. Apparatus for Manufacture of Wood Gas. J. D. Averill, Brooklyn, N. Y.
411,875. Safety Gas Pressure Regulator. C. M. Ryder, Findlay, Ohio.
412,066. Safety Gas Cock. J. P. Becker, San Francisco, Cal.
412,135. Process of Gas Manufacture. T. G. Springer and M. A. Morse Chicago, Ills.

ISSUE OF OCTOBER 8, 1889.

412,664. Apparatus for Impregnating Liquids with Gas. W. Radam, Austin, Texas.
412,678. Gas Generator. A. O. Smith, Sheboygan, Wis.
412,694. Gas Burner. D. K. Baker and C. H. Green, Chicago, Ills.

ISSUE OF OCTOBER 15, 1889.

412,883. Operating Gas Engines. S. Griffin, Bath, Somerset, England.
412,966. Apparatus for Manufacturing Gas. J. F. Mendenhall, Springfield, Ohio.

The Market for Gas Securities.

Consolidated sold off slightly during the week, but is now fairly steady at 90 to 90¼. Holders may rest assured that the next dividend will be at the increased rate of six months ago—*i. e.*, 2½ per cent. Equitable and Mutual are steady, and some active inquiry has been made for the former. Brooklyn shares are more in demand, and the bid prices are also in the ascending scale. Chicago Trusts sold off to 54½. To-day 232 shares of stock in the Homer and Cortland (N. Y.) Gas Light Company will be sold at auction by Messrs. Hubbell & Hiscock, receivers of the assets of the Messrs. Wilkinson. The Brockton (Mass.) Gas Light Company gives notice that its outstanding bonds will be redeemed on presentation. Interest on the same will cease on November 17.

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At a Meeting of the Gas Trustees of the City of Findlay, held August 28th, it was "Resolved, That we recommend the general adoption of the Welsbach Light, owing to its excellence and economy in the use of gas."

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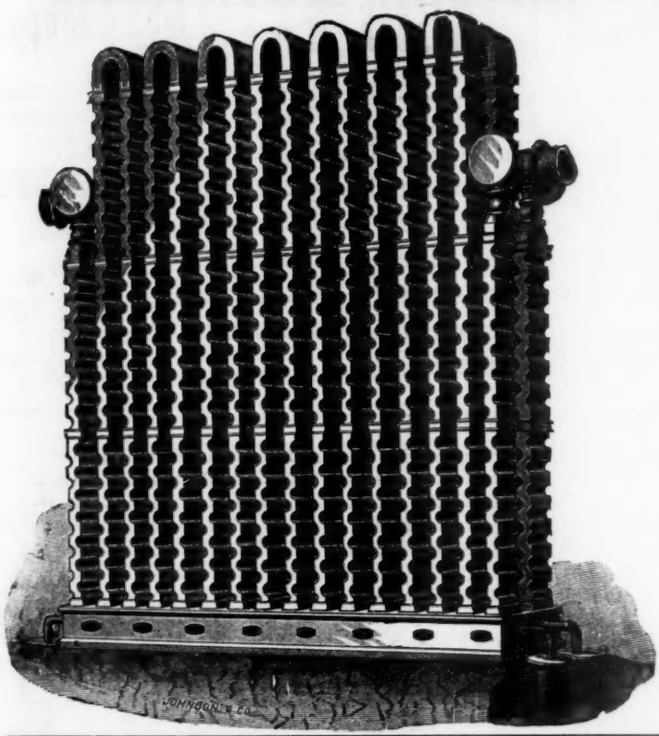

We desire to draw the attention of the gas community to the merits of the SINUOUS FRICTION CONDENSER. Companies intending to introduce new condensers into their works will do well to confer with us and examine plans and estimates before contracting for any other pattern The FRICTION CONDENSER is now in use at the gas works located in the following places:

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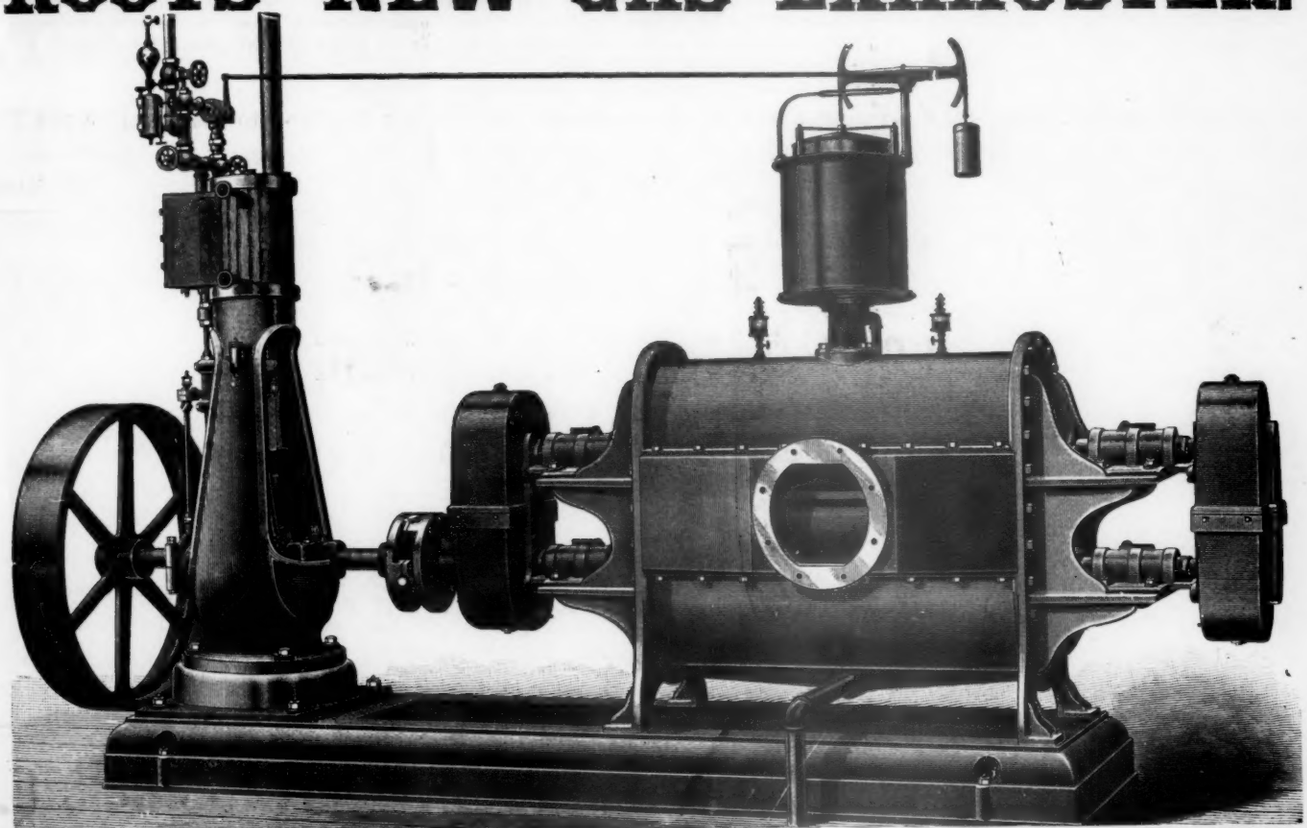

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A very general demand exists, in both large and small Gas Works, for an apparatus that will be absolutely efficient in the removal of the tar which passes the hydraulic main and condenser. Many attempts have been made to accomplish this, but, I believe, without success, until the introduction, five years ago, in England, of the C. & W. Walker Patent Tar and Carbonic Acid Extractor. During these years this apparatus has been adopted by many of the most prominent Engineers, not only in England, but also on the Continent of Europe and in other parts of the world. It is only necessary to give here a partial list in order to convince any intelligent American Gas Engineer that this machine must have succeeded fully in accomplishing the desired results.

The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

I have taken the Agency for the United States for this apparatus, and am now prepared to make contracts to erect it on the premises of any Gas Company. It would be manufactured in the following sizes:

No. 1,	50,000	to	100,000	cu. ft.	per	24 hrs.,	3	ft.	square,	5 ft. deep.
No. 2,	"	"	125,000	"	"	"	4	"	"	" "
No. 3,	"	"	250,000	"	"	"	5	"	"	" "
No. 4,	"	"	500,000	"	"	"	6	"	"	" "
No. 5,	"	"	750,000	"	"	"	7	"	"	" "
No. 6,	"	"	1,000,000	"	"	"	8	"	"	" "
No. 7,	"	"	1,250,000	"	"	"	9	"	"	" "
No. 8,	"	"	1,500,000	"	"	"	10	"	"	" "
No. 9,	"	"	2,000,000	"	"	"	12	"	"	" "
No. 10,	"	"	3,000,000	"	"	"	15	"	"	" "

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results will be guaranteed in every instance.

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Wellington Light & Heat Co.	Wellington, Kansas.
Chippewa Falls Gas Lt. Co.	Chippewa Falls, Wis.
Elkhart Gas Lt & Coke Co.	Elkhart, Ind.
Madison City Gas Light Co.	Madison, Wis.
South Bend Gas Light Co.	South Bend, Ind.
Sheboygan National Gas Co.	Sheboygan, Wis.
Salina Gas Light Co.	Salina, Kansas.
The Rathbun Co	Deseronto, Prov. Ont.
Jefferson City Gas Lt. Co	Jefferson City, Mo.
Mankato Gas Light Co.	Mankato, Minn.
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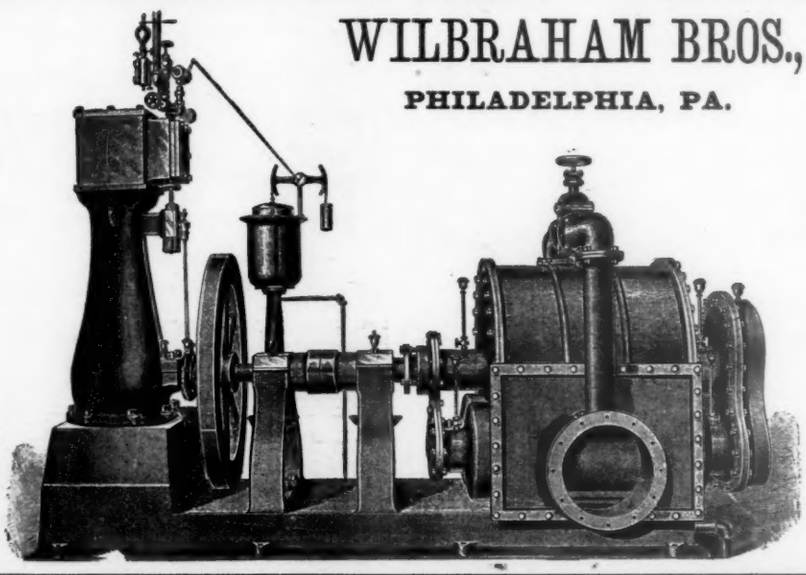

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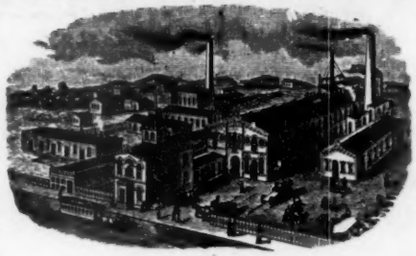

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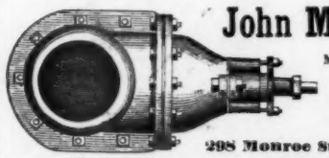

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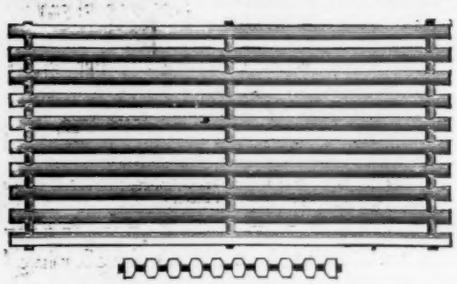

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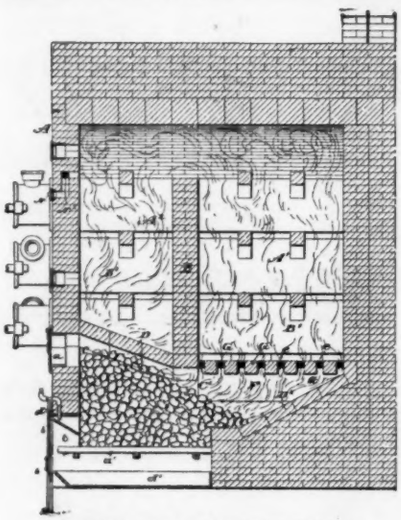

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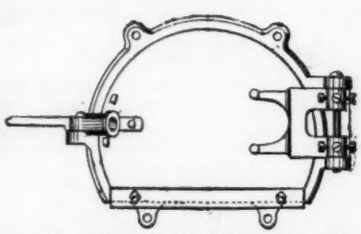

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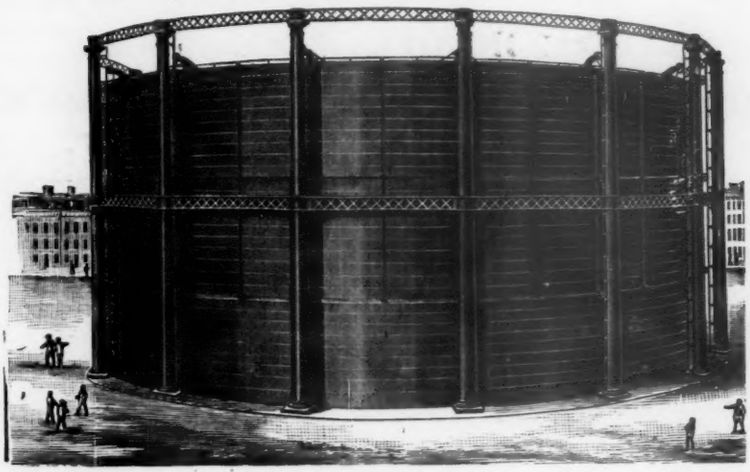

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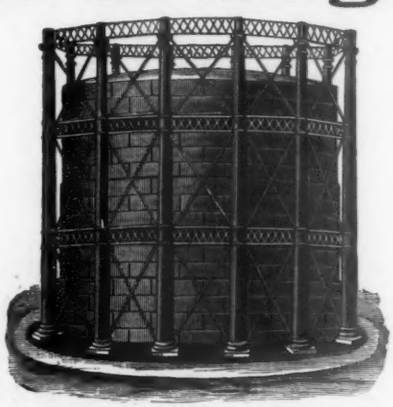

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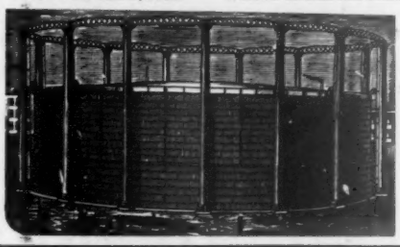
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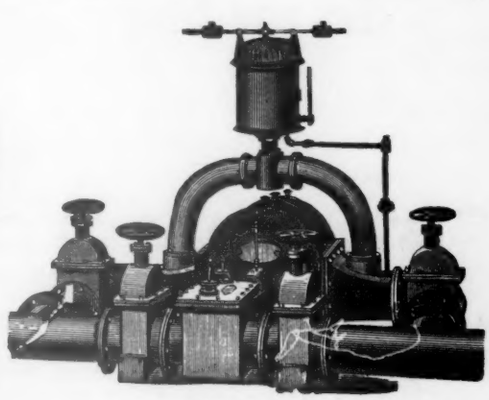

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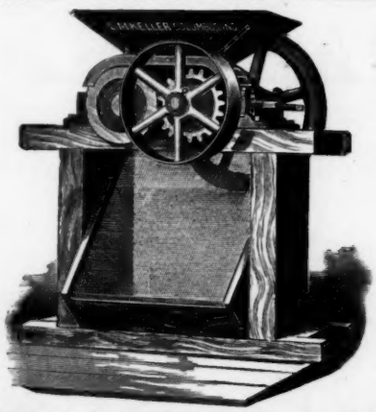

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The Most Economical, Efficient, and Durable Gas Stove Made.

GAS COOKING STOVE, No. 8 C.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
37 in. high.	12 in. high.	12 in. high.	24 in. long.	36 in.
20 in. wide.	17¼ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.
Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.
The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crossplecces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
31 in. high.	9¼ in. high.	10 in. high.	21 in. long.	32 in.
27 in. wide.	14¾ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.

"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6¼ inches diameter, 3 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.
Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.
¾ in. supply pipe should be used where the pressure is 1 in. or over.